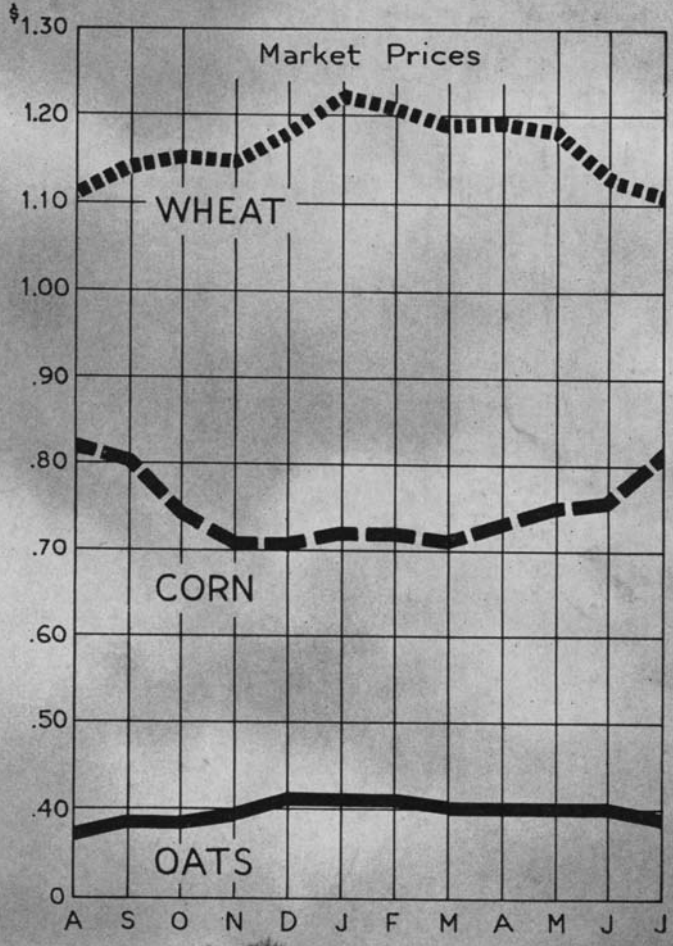
# WHEN—

# Should Grain Be Marketed?




Circular 516

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ACKNOWLEDGMENT

THIS CIRCULAR includes material from a number of Illinois Station publications which are now out of print. The discussion on cost of storing corn is largely based on Bulletin 295, "Cost of Storing Corn on the Farm," by L. F. Rickey, published in June, 1927. This was the first publication on marketing issued by the Station after the Purnell Act of 1925 had provided funds for expansion of research in this field. Bulletin 295 in turn contained material from Bulletin 183, "Prices and Shrinkage of Illinois Grains," by W. L. Burlison and O. M. Allyn, published in 1915. Material on price analysis has been brought up to date from Bulletin 324, "Seasonal Features of Illinois Grain Marketing," by L. J. Norton and C. L. Stewart, published in May, 1928.

## CONTENTS




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# When Should Grain Be Marketed?

By L. J. Norton, Chief in Agricultural Marketing

EVERY FARMER who raises grain for sale faces the problem of deciding when he can sell it most advantageously. A carefully considered decision will be based on: (1) probable changes in price; (2) costs involved in holding the grain; (3) storage space, tenure relationships, need for funds, and other such personal considerations; and (4) possible damage from insects. Altho for a given farmer any one of the items included in the third group may determine his decision, it will be assumed in the following discussion that he does have freedom of choice as to time of sale—that he is in position to hold his grain if he thinks that holding it will be the profitable thing to do.

Obviously no blanket rule can be laid down that will indicate for every farmer every year just when he should market his crops in order to realize the most money for them. But it is possible to give facts on which any farmer can work out his own marketing policy with reasonable confidence. That is the purpose of this circular. The times that have proved best in past years for marketing the various crops are shown, as well as the results had different policies been followed. Trends in prices and in the seasons when farmers have marketed their crops are shown, and average storage costs worked out. With a background of such information, and a clear grasp of the circumstances that will affect the marketing situation in the year actually at hand, a farmer is in position to make his own decisions.

In Illinois four principal kinds of grain are raised for sale: corn, oats, wheat, and soybeans. Each of these is discussed separately in the following sections.

## WHEN TO MARKET CORN

### SALES TRENDS IN MARKETING YEAR

In the cash-grain areas of Illinois corn is customarily sold thruout the year. Shipments by Illinois elevators—which corresponded closely with sales by farmers—were distributed as shown on the following page during the four years 1923-1926, when a study of them was made.[1]

[1]Norton, L. J. and Stewart, C. L. Seasonal features of Illinois grain marketing. Ill. Agr. Exp. Sta. Bul. 324. 1929.

| | *Percent of yearly shipments* |
|---|---|
| July thru October | 29.8 |
| November thru February | 44.3 |
| March thru June | 25.8 |

Shipments were highest in January (13.7 percent of the year's shipments) and lowest in April (4.2 percent).

During the years 1927-1937 about two-thirds of the previous year's crop and carryover was, on the average, still on farms on January 1; about two-fifths was still there on April 1 at the end of the winter feeding season; about one-fourth remained on July 1, and about one-tenth was still on hand on October 1 at the beginning of the next marketing year (Table 1). Hence about 60 percent of the crop and carryover of corn was fed or sold in the first half of the marketing year and about 30 percent in the second half, the balance being carried over. Heavy feeding on the farms where the corn was grown largely explains the heavy disappearance of corn up to January 1.

The season of marketing corn is largely determined by the demand for it, as the bulk of the crop, regardless of its ultimate use, is stored on the farm where it is grown. When a strong demand arises, such as that caused by a heavy export movement, the bulk of the corn to meet that demand has to be bought in the country. This was what happened during the heavy export movement of corn following the 1937 harvest.

The seasonal pattern in the marketing of corn has not changed much since 1923-1926 in spite of the fact that earlier marketing has been made possible by greater use of mechanical corn pickers and

TABLE 1.—ILLINOIS CORN: PERCENTAGE OF PREVIOUS CROP AND CARRYOVER ON FARMS ON DESIGNATED DATES, 1927–1937 CROPS

| Marketing year | Size of crop | Current crop plus October 1 carryover | Percentage of previous crop and carryover still on farms on— | | | |
|---|---|---|---|---|---|---|
| | | | January 1 | April 1 | July 1 | October 1 |
| | *1,000 bu.* | *1,000 bu.* | | | | |
| 1927–28 | 242 304 | 284 070 | 58.0 | 28.1 | 11.1 | 2.1 |
| 1928–29 | 317 110 | 322 925 | 64.8 | 36.3 | 22.6 | 5.9 |
| 1929–30 | 275 977 | 295 004 | 66.4 | 41.2 | 19.6 | 5.6 |
| 1930–31 | 220 212 | 236 771 | 65.1 | 39.1 | 22.3 | 9.3 |
| 1931–32 | 329 078 | 351 099 | 73.1 | 47.8 | 31.9 | 13.1 |
| 1932–33 | 397 879 | 443 950 | 75.3 | 52.9 | 35.0 | 21.5 |
| 1933–34 | 222 282 | 317 773 | 62.3 | 39.9 | 25.9 | 11.2 |
| 1934–35 | 148 357 | 183 922 | 64.5 | 36.3 | 18.6 | 4.0 |
| 1935–36 | 299 722 | 307 140 | 77.1 | 44.9 | 21.5 | 5.9 |
| 1936–37 | 197 928 | 215 911 | 61.4 | 54.5 | 11.5 | 5.5 |
| 1937–38 | 420 227 | 432 105 | 77.8 | 27.5 | 33.1 | 19.5 |
| Average, 1927–1937 | ..... | ..... | 67.8 | 40.8 | 23.0 | 9.4 |

trucks and the planting of hybrid corn. Neither has the actual season of marketing corn been affected greatly by Commodity Credit Corporation loans to farmers.

This spreading over the year of sales of corn by farmers is a reflection of the following facts: (1) corn can be conveniently and cheaply stored on the farm; (2) a considerable portion of farmers believe it pays them to hold their corn; (3) financial resources of large numbers of such farmers have been ample to permit such holding; and (4) the demand for corn—depending largely on the needs for feed and food—is distributed over the year. Anyone who observes the marketing of corn in the cash-corn areas of Illinois will be impressed by the way in which sales respond to price changes—selling being heavy when the price is satisfactory (the actual price may be 50 cents, as in 1937-38, or $1, as in 1936-37), and resistance to sales being stubborn when prices are considered too low.

## TYPICAL PRICE CHANGES

Since corn is harvested over a period of a few weeks and is consumed thruout the year, it would be expected that the price would be

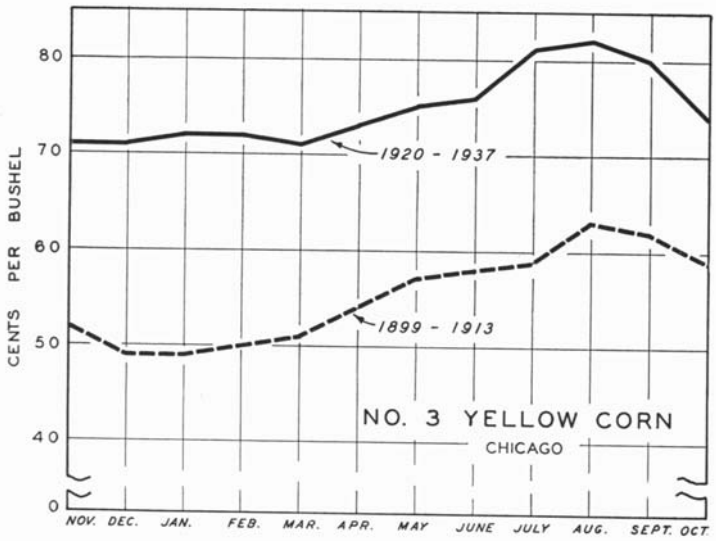


**Fig. 1.—Average monthly price of No. 3 yellow corn at Chicago for the crops of 1899-1913 and 1920-1937**

Most of the seasonal increase in the price of corn has occurred typically between March and August. From November to March the price has, on the average, remained fairly constant.

TABLE 2.—MONTHLY AVERAGE PRICES FOR NO. 3 YELLOW CORN AT CHICAGO, 1899–1913 AND 1920–1937

| Month | Average price per bushel in— | | Month | Average price per bushel in— | |
|---|---|---|---|---|---|
| | 1899-1913 | 1920-1937 | | 1899-1913 | 1920-1937 |
| | *cents* | *cents* | | *cents* | *cents* |
| November | 52 | 71 | May | 57 | 75 |
| December | 49 | 71 | June | 58 | 76 |
| January | 49 | 72 | July | 59 | 81 |
| February | 50 | 72 | August | 63 | 82 |
| March | 51 | 71 | September | 62 | 80 |
| April | 54 | 73 | October | 59 | 74 |

lowest at harvest time (late fall and early winter), and that it would rise during the marketing year as storage costs accrue from month to month. Any advantage in rising prices during the marketing season would, however, be partly canceled off by the fact that corn normally loses moisture during storage and hence loses weight. But the loss in moisture may improve the grade enough to offset the loss in weight. So it is clear that comparisons of corn prices at different times of the year to be valid must be based on a given grade with a definite range in moisture content.

Average monthly prices of No. 3 yellow corn for different periods are shown in Fig. 1 and Tables 2 and 3. As an average of the eighteen crops from 1920 to 1937,[1] no increase in price took place from November to March; but from March to July the price advanced 10 cents a bushel, with half the increase occurring between the June and July averages. From July to September the price averaged about the same, August prices being slightly the highest. From September to November the average declined 13 cents.

No advance in the market price from November to March was needed during this period from 1920 to 1937 to encourage the holding of corn, the average increase after March being enough to encourage storage for the entire period; and presumably the average increase covered the costs of storage as calculated by farmers. Altho some corn is usually carried into late summer by stockmen who do not wish to sell their surplus until a new crop is in sight, many cash-grain farmers store corn until summer because they expect the price to rise more than enough to pay the costs involved.

[1] In 1937 the corn-sealing program had not yet become of sufficient scope to modify the seasonal variations in corn prices.

TABLE 3.—DIRECTION OF CHANGE IN PRICE FROM PREVIOUS MONTH: NO. 3 YELLOW CORN AT CHICAGO, 1920–1937 CROPS

| Month | Average change from previous month | Number of years when price went— | | Average total change from November |
|---|---|---|---|---|
| | | Up | Down | |
| | *cents* | | | *cents* |
| November | −5 | 7 | 10 | .... |
| December | 0 | 8 | 8 | 0 |
| January | +1 | 11 | 6 | +1 |
| February | 0 | 5 | 12 | +1 |
| March | −1 | 6 | 9 | 0 |
| April | +2 | 10 | 7 | +2 |
| May | +2 | 8 | 6 | +4 |
| June | +1 | 9 | 8 | +5 |
| July | +5 | 13 | 4 | +10 |
| August | +1 | 7 | 9 | +11 |
| September | −2 | 5 | 12 | +9 |
| October | −6 | 2 | 16 | +3 |

The monthly price changes listed as averages in Table 2 of course varied from year to year both in direction and in extent (Table 3 and Fig. 2). From October to November the price declined more often than it advanced; in December it was lower than in the preceding month as often as it was higher; in January it was more commonly higher; in February and again in March it was more commonly lower.

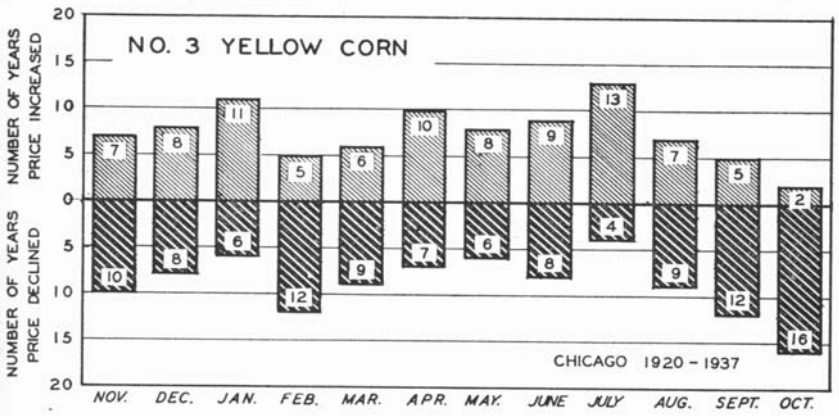


**Fig. 2.—Number of times during eighteen crop years that the monthly price of No. 3 yellow corn at Chicago was higher or lower than that of previous month, 1920-1937**

In the three months—January, April, and July—the price of corn most commonly averaged higher than in the previous month. In February, September, and October it averaged lower more than twice as frequently as it averaged higher. In October there were only two years of the eighteen when it did not average lower than in September.

In April, May, June, and July (and most frequently in July) it was more commonly higher than in the preceding month. In July crop scares are more common than in other months, and heavy field work then makes it more difficult for farmers to market corn. After July, decreases from one month to the next are more common than increases, for during those months the new crop is developing and the price is being adjusted to the new-crop basis.

This pattern of average monthly corn prices may be modified somewhat in the future, particularly if the Commodity Credit Corporation continues to make price-stabilization loans on corn. In years when the loan value is above the market price such loans will tend to delay marketing, cause the market price to advance earlier in the season, and diminish the usual April-July seasonal rise. In years when a large volume of grain is under seal or owned by the Government, the corn market may be so tightened up, especially during the latter part of the marketing season, as to maintain prices at a time when they are normally expected to decline. This was what happened in the 1939-40 season, when the loan program was in full operation. But in years when the market price is above the loan price, more nearly normal seasonal patterns are likely.

## WHY SEASONAL PRICE CHANGES VARY

Departure in any given year from the average seasonal variations described in the foregoing section is usually the result of one or more of the following conditions:

(1) *A very short corn crop.* In marketing years following very short crops of corn the peak in prices has come most frequently early in the marketing season, usually in December or January. The high prices and scarcity of feed so reduce the numbers of livestock, especially of hogs, that the demand for corn declines later in the season. Also, two very short corn crops have never yet occurred in succession. In the summer after a short crop consumers look forward to larger supplies from the new crop and consequently economize in the use of corn. Hence in such years the price of corn has typically worked lower from the high level reached early in the season.

(2) *A large corn crop after a short crop.* When a large crop follows a very short crop, livestock numbers and consequently consumption of feed are usually below average at the start of the marketing year. Corn supplies therefore tend to be more than ample thruout the marketing year, and prices are likely to increase very little unless a crop scare develops in the following summer.

(3) *A large increase in number of hogs during the corn-marketing season.* When the number of hogs is greatly increased during a corn-marketing season, the price of corn is likely to advance more than usual, for supplies rapidly decline as consumption increases.

(4) *Pronounced changes in the general price-level.* In periods when the general price-level is rapidly rising or falling, the rise or fall may considerably influence the seasonal price pattern of corn. A pronounced rise in the general price-level will tend to accentuate the seasonal rise in prices for corn and diminish the seasonal price decline, while a pronounced fall in the general price-level will have the reverse effects.

## ITEMS IN COST OF STORING CORN

Among the costs involved in storing corn are (1) interest, (2) use of crib for storage, (3) insurance, (4) taxes, and (5) shrinkage and deterioration, including losses from insect and rodent damage.

### Interest Always a Cost in Holding Corn

When corn is sold early, interest may be earned on the proceeds, or debts may be paid and the interest on them saved. If corn is 50 cents a bushel, the interest per bushel at different rates would be as follows:

| *Rate* | *Interest for—* | |
|---|---|---|
| | *1 year* | *1 month* |
| 6% | 3 cents | ¼ cent |
| 5% | 2.5 cents | About ⅕ cent |
| 4% | 2 cents | ⅙ cent |
| 3% | 1.5 cents | ⅛ cent |

With 75-cent corn these interest costs would be 50 percent greater, and with dollar corn they would be twice as large.

### Storage Space Not Always a Cost

Corn must usually be stored until it is sold or used. Cost of storage is therefore a logical charge against the crop rather than against the cost of holding it, for whether the cribs are in use for one month or ten months of the year makes little difference in the cost of providing and maintaining them. Of course if it is necessary to build new storage space in order to hold a crop a second year, the cost of erecting and maintaining it must be included in the storage costs.

Assuming that a good substantial crib can be built for about 30 cents a bushel of storage space, the yearly cost of its use will be about 3 cents a bushel (annual depreciation, upkeep, insurance, taxes, and

interest on investment usually amount to about 10 percent of the original cost). Cribs of a more temporary type can be built at a lower cost, but they will depreciate faster.[1]

Storage of corn at terminal markets is seldom practical for farmers, for several reasons. The current charge at Chicago is 1¼ cents a bushel for unloading and elevating, including storage for the first ten days. Thereafter the charge is $\frac{1}{30}$ cent a bushel a day, or approximately 1 cent a month. Corn so stored is mixed with other corn of the same grade, and when delivery is asked for, the same quantity and grade is delivered as was stored. Shrinkage therefore does not enter into the cost of storing corn in public elevators at terminal markets; but the storer runs the risk of getting back grain of somewhat lower quality than the grain he stored, even tho it is the same grade. Corn having a high content of moisture is not accepted for storage; and if while in storage it starts to go out of condition, the elevator can order it removed. Also, corn may be delivered from storage with less favorable railroad billing than it had when it was delivered to the elevator, and this less favorable billing may reduce its sale value.

A country grain buyer who stores grain for farmers in Illinois must obtain a federal or state license, must establish a schedule of storage charges, charge all who store at the same rate, and, except under a special type of license, store up to the limit of his storage capacity for anyone who requests the service. According to surveys, very few country grain dealers in Illinois had taken out such licenses before the fall of 1939. In one survey of 104 mills and elevators in southern Illinois in 1938 only three were licensed to store grain under the U. S. Warehouse Act and four under the Illinois Warehouse Act. In that section of Illinois wheat is stored by the elevators to a greater extent than corn. Charges reported for storing wheat were either 1 cent a bushel a month or $\frac{1}{30}$ cent a day. In communities where local elevators store grain for farmers, the most usual rate is probably 1 cent a month. In the fall of 1939 more elevator companies took out storage licenses in order to store corn either for the Commodity Credit Corporation or for farmers, in connection with the "ever-normal granary" program. Charges for such storage in 1939-40 were 1 cent a bushel a month, with a maximum of 7 cents for twelve months.

[1]Information on the construction of cribs may be obtained on request from the Department of Agricultural Engineering of the Illinois Agricultural Experiment Station at Urbana.

### Insurance Charges Vary With Length of Storage

Expense of insuring corn is an item of storage cost, for the risk exists whether it is carried by the owner or passed on to an insurance company. Insurance rates vary a good deal according to the type of company writing the policy and the risks insured against. Assuming a rate of $1.25 per $100 for fire and windstorm insurance for twelve months; 50 percent of this rate, or 62.5 cents, for four months; 70 percent, or 87.5 cents, for six months; and 80 percent, or $1 for eight months, the cost of insurance for corn valued at 50 cents a bushel would be about 3/10 cent a bushel for four months, about 2/5 cent for six months, and 1/2 cent for eight months. For storage from November thru June, the cost would be 1/2 cent a bushel for 50-cent corn at the above rate. With a Commodity Credit Corporation loan, the insurance rate is 50 cents per $100; or on a loan of 61 cents a bushel, about 3/10 cent a bushel for a year's storage.

### Taxes Depend on Time of Storage

Whether taxes are an item in storage cost depends on whether corn is in store on the assessment date. If the corn is sold before that date, taxes are not a cost; if it is sold afterwards, they are. If corn is worth 50 cents a bushel and is assessed at one-third its full value, taxes will amount to 1/6 cent a bushel for each dollar of tax rate per $100 of assessed valuation. Accordingly, taxes are not a very important item of cost in storage of corn.

### Shrinkage Cost Usually Offset by Better Grade

When corn is sold by grade, either as shelled corn (most Illinois farmers who sell corn sell it shelled) or as ear corn, the loss in weight usually does not reduce the total value of the corn. Shrinkage usually is simply a loss of moisture, and such loss is likely to improve both the quality of the grain and its price, as may be seen from the grade requirements for shelled corn listed in Table 4. A reduction in moisture content from 23 percent to 14 percent would be sufficient, if the corn meets the specifications for No. 1 corn in other respects, to improve the grade from No. 5 to No. 1.

If, however, some factor other than moisture content determines the grade, then shrinkage may become an item of cost. In farm-stored corn, damage to kernels (chiefly by insects, molds, and rots) frequently lowers the grade. If corn is so damaged as to grade No. 4, for example, a reduction in moisture from 20 percent to 14 percent will not raise the

grade to No. 1; it will still be No. 4. But the drier corn will usually sell at a somewhat higher price.

How is a farmer to know how much shrinkage to expect of corn in storage? Even tho the corn may be stored on the farm as ear corn, the method of computing the shrinkage depends on whether the corn is to be marketed on the ear or shelled.

TABLE 4.—GRADE REQUIREMENTS FOR YELLOW CORN, WHITE CORN, AND MIXED CORN
(U. S. Department of Agriculture standards as revised to 1940)

| Grade No. | Minimum test weight per bushel | Maximum limits of— | | | |
|---|---|---|---|---|---|
| | | Moisture | Cracked corn and foreign material | Damaged kernels | |
| | | | | Total | Heat-damaged |
| | *lb.* | *perct.* | *perct.* | *perct.* | *perct.* |
| 1 | 54 | 14 | 2 | 3 | .1 |
| 2 | 53 | 15.5 | 3 | 5 | .2 |
| 3 | 51 | 17.5 | 4 | 7 | .5 |
| 4 | 48 | 20 | 5 | 10 | 1.0 |
| 5 | 44 | 23 | 7 | 15 | 3.0 |
| Sample grade | Sample grade shall include corn of the class Yellow Corn, or White Corn, or Mixed Corn, which does not come within the requirements of any of the grades from No. 1 to No. 5, inclusive; or which contains stones and/or cinders; or which is musty, or sour, or heating, or hot; or which has any commercially objectionable foreign odor; or which is otherwise of distinctly low quality. | | | | |

**Corn to be marketed shelled.** Shrinkage of corn to be marketed shelled depends primarily on the comparative moisture content of the grain when stored and at the time of sale. The moisture content can be determined by the moisture testers in use in most country elevators that handle corn in volume. The sample that is used should be representative of the crib, should be shelled immediately, placed in a moistureproof container, and mixed thoroly before testing. Moistureproof containers now used in connection with Commodity Credit Corporation corn loans are handy for this purpose.

If the moisture content of a given lot of corn is 23 percent at the time the corn goes into storage and 13 percent when it is sold, the shrinkage is *not* 10 percent (23 percent *minus* 13 percent), but is 11.5 percent, as shown by the following example:

> 500 pounds of corn having 23 percent moisture contains 115 pounds of water and 385 pounds of dry matter. When the corn dries down to 13 percent moisture, the amount of dry matter will still be about the same, 385 pounds.

In corn containing 13 percent moisture, the dry matter equals 87 percent of the total weight. If, therefore, 385 pounds equals 87 percent of the total weight of the corn, the total weight equals 385 lb. ÷ .87, or 442.5 pounds.

Hence the shrinkage is 57.5 pounds (500 lb. — 442.5 lb. = 57.5 lb.).

The percentage of shrinkage is 57.5 lb. ÷ 500 lb. × 100 = 11.5 percent.

By using this method, the number of bushels of stored corn that will be left after natural drying can be readily determined. To estimate beforehand how much shrinkage will take place in storage it is necessary to estimate what the moisture percentage will be when the corn is sold. This will depend on the weather and how well the crib protects the corn from snows and rains.

What shrinkage to expect in corn containing various amounts of moisture before and after drying are indicated in Table 5. In these calculations shrinkage from any cause other than loss of moisture is disregarded. Unless corn with a high percentage of moisture is stored during rather warm weather, these other losses are likely to be small, according to available experimental evidence.

Shrinkage of corn in storage can thus be fairly closely estimated. *Whether it is to be considered a storage cost depends both on the price-level of corn and on the discount taken for moisture.* Unless the grade is lowered by damage or some other factor besides moisture, the bushel-price will be higher the drier the corn. With corn at about 50 cents a bushel, a common price scale is "½ cent for each ½ percent difference in moisture." To illustrate, if the price is 50 cents for corn having 15 percent moisture, the discount would be 5 cents on corn having

TABLE 5.—SHRINKAGE IN SHELLED CORN DRIED NATURALLY TO SPECIFIED MOISTURE CONTENTS, ASSUMING 1,000 BUSHELS WHEN CRIBBED

| Moisture in corn when cribbed | Original grade, if moisture is limiting factor | Amount of corn remaining[a] when moisture is reduced to— | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 19 perct. | 18 perct. | 17 perct. | 16 perct. | 15 perct. | 14 perct. | 13 perct. | 12 perct. |
| *perct.* | | *bu.* | *bu.* | *bu.* | *bu.* | *bu.* | *bu.* | *bu.* | *bu.* |
| 28 | Sample | 889 | 878 | 867 | 857 | 847 | 837 | 828 | 818 |
| 26 | Sample | 914 | 902 | 892 | 881 | 871 | 860 | 851 | 841 |
| 24 | Sample | 938 | 927 | 916 | 905 | 894 | 884 | 874 | 864 |
| 23 | 5 | 951 | 939 | 928 | 917 | 906 | 895 | 885 | 875 |
| 22 | 5 | 963 | 951 | 940 | 929 | 918 | 907 | 897 | 886 |
| 21 | 5 | 975 | 963 | 952 | 940 | 929 | 919 | 908 | 898 |
| 20 | 4 | 988 | 976 | 964 | 952 | 941 | 930 | 920 | 909 |
| 19 | 4 | 1 000 | 988 | 976 | 964 | 953 | 942 | 931 | 920 |
| 17.5 | 3 | .... | ... | 994 | 982 | 971 | 959 | 948 | 938 |

[a]The quantities listed were obtained by dividing the percentage of dry matter in the corn at the beginning of storage (100 minus original percentage of moisture) by the percentage of dry matter remaining at the end of the storage period (100 minus final percentage of moisture) and multiplying by 1,000.

20 percent moisture. Comparative values of equivalent quantities of corn would then be:

1,000 bushels having 20 percent moisture, at 45 cents a bushel = $450
941 bushels having 15 percent moisture, at 50 cents a bushel = $470.50

With this price scale the shrinkage in weight would be offset by the higher price, and the corn would be worth $20.50 more when dried out. To put it another way, a price of 47 cents a bushel for corn having 20 percent moisture would be equal to 50 cents a bushel for the same corn when dried to 15 percent moisture. Thus at the 50-cent price-level a 3-cent difference in price rather than a 5-cent difference would equalize the value of equivalent quantities of corn having 20 percent and 15 percent moisture. Of course the intrinsic value of corn either for commercial or feed use depends upon the amount of dry matter it contains.

But the question is affected by the price-level for corn as well as by the discounts for moisture. Assuming a price of $1.00 a bushel for corn having 15 percent moisture and the same scale of discounts for greater amounts of moisture, the values of equivalent amounts of corn would then be:

1,000 bushels having 20 percent moisture, at 95 cents a bushel = $950
941 bushels having 15 percent moisture, at $1.00 a bushel = $941

The price difference at this level would need to be 5.9 cents a bushel to put the two on a substantially equal basis.

In practice, however, the discounts for moisture would be larger at the higher price-level, and the actual difference in price would be larger than in this example. The same scale of discounts was used in these two examples in order to show the influence of price-level on the problem.

**Corn to be sold on ear and graded.** When corn is sold on the ear and graded, the problem of deciding whether shrinkage should be included as a storage cost is very similar to that when corn is to be marketed shelled, except that the method of figuring the shrinkage is different; the loss of weight of the cobs, as well as of the grain, must be taken into consideration.

Figures on the shrinkage of ear corn are available from tests made at the Illinois Agricultural Experiment Station from 1903 to 1913 and from 1924 to 1930 (Tables 6 and 7). The general procedure during the earlier period was described as follows:

"Each year about 300 bushels of corn was hauled direct from the field and placed in an open crib, protected by tight roof and by slat sides, where

TABLE 6.—CUMULATIVE SHRINKAGE OF EAR CORN, BY MONTHS, FOR YEARS 1903–1913 AT URBANA, ILLINOIS[a]

(Shrinkage expressed as percentage of original weight)

| | 1903 | 1905 | 1906 | 1907 | 1909 | 1910 | 1911 | 1912 | 1913 | Average for 9 years |
|---|---|---|---|---|---|---|---|---|---|---|
| *Month when tested*[b] | | | | | | | | | | |
| November | .8 | 2.5 | 1.1 | (−.1) | 1.8 | .... | 1.9 | .... | .... | 1.3 |
| December | 3.2 | 5.5 | 2.8 | 2.2 | 4.5 | 1.2 | 5.0 | 1.7 | .... | 3.3 |
| January | 4.5 | 6.7 | 3.3 | 4.5 | 4.8 | 2.7 | 6.8 | 3.0 | 1.1 | 4.2 |
| February | 5.6 | 8.6 | 4.9 | 6.3 | 6.5 | 3.8 | 7.5 | 3.9 | 2.3 | 5.5 |
| March | 6.9 | 8.5 | 7.3 | 9.4 | 9.2 | 6.9 | 7.6 | 5.0 | 1.9 | 7.0 |
| April | 11.1 | 10.0 | 10.5 | 12.4 | 13.5 | 8.7 | 11.4 | 7.2 | 5.1 | 10.0 |
| May | 15.4 | 13.6 | 11.9 | 13.8 | 13.7 | 12.4 | 17.1 | 11.2 | 8.9 | 13.1 |
| June | 17.9 | 14.2 | 13.2 | 16.8 | 15.7 | 15.1 | 20.3 | 13.2 | 11.3 | 15.3 |
| July | 19.0 | 15.3 | 14.1 | 18.0 | 15.7 | 16.8 | 20.3 | 13.6 | 12.5 | 16.2 |
| August | 20.2 | 15.1 | 14.8 | 19.0 | 15.6 | 16.9 | 21.1 | 13.5 | 13.3 | 16.6 |
| September | 19.8 | 15.2 | 15.2 | 20.1 | 14.8 | 15.4 | 21.3 | 13.7 | 12.1 | 16.4 |
| October | 19.8 | .... | 15.5 | 20.6 | 14.9 | 14.7 | 21.6 | 12.2 | 13.0 | 16.5 |
| November | 19.9 | .... | 15.1 | 20.2 | 15.4 | 14.7 | 21.6 | 11.2 | 12.4 | 16.3 |
| December | .... | .... | .... | .... | .... | .... | .... | 10.1 | .... | .... |

[a]With the exception of 1904 and 1908, for which data are not available. Data are from Ill. Agr. Exp. Sta. Bul. 183, "Prices and Shrinkage of Farm Grains," 1915. [b]Average of four weighings each month.

it was left until the next crop was gathered. Four times each month the crib and its contents were weighed to determine the shrinkage. The average of the four weighings was taken as the monthly average from which to compute the shrinkage of the corn."[1]

No data on moisture content of the corn at the time it went into storage were taken during these early years, as the methods now employed for determining the percentage of moisture in corn were not in common use at that time. During the later years, 1924 to 1930, the general procedure was the same as in 1903 to 1913 except that percentages of moisture were taken at the time the corn was cribbed, and weighings were made only at the end of each month, instead of four times during the month (Table 7).

In these experiments the most rapid shrinkage occurred in April, May, and June. After January the shrinkage rate increased gradually until May and then decreased. The minimum weight was reached in August. On the average, the cumulative loss in weight was by July about one-sixth of the original weight. After July there was very little change in weight.

The amounts of shrinkage differed considerably in different years or even in the same year (1924, 1927), depending chiefly on the amount of moisture in the corn when it was cribbed. When the corn was well matured and comparatively dry at husking time, the shrinkage

[1]Burlison, W. L. and Allyn, O. M. Prices and shrinkage of farm grains. Ill. Agr. Exp. Sta. Bul. 183. 1915.

from November to the following summer was around 14 or 15 percent; and when it was especially dry, as in 1930, the shrinkage to August was only 8.3 percent. On the other hand, when corn going into the crib contained more moisture, the shrinkage amounted to 18 or 20 percent,

TABLE 7.—MOISTURE CONTENT OF EAR CORN WHEN CRIBBED AND CUMULATIVE SHRINKAGE BY MONTHS, 1924–1930, AT URBANA, ILLINOIS[a]
(Shrinkage expressed as percentage of original weight)

| Moisture percentage when cribbed..... | 19.9 | 23.4 | 25.5 | 26.8 | 29.6 | 31.3 | 42.9 |
|---|---|---|---|---|---|---|---|
| Date when cribbed..... | November 1930 | November 1924 | November 1927 | December 1929 | December 1926 | December 1927 | December 1924 |
| *Month when tested*[b] | | | | | | | |
| December..... | 1.44 | 3.81 | 5.65 | .42 | 1.75 | ..... | 1.17 |
| January..... | 2.15 | 4.61 | 7.15 | 1.29 | 3.76 | 3.34 | 1.73 |
| February..... | 2.58 | 5.62 | 8.36 | 2.80 | 6.06 | 9.14 | 2.63 |
| March..... | 2.66 | 7.79 | 11.60 | 5.96 | 10.36 | 15.43 | 6.83 |
| April..... | 4.48 | 11.44 | 12.50 | 10.70 | 12.76 | 19.41 | 25.39 |
| May..... | 5.86 | 12.82 | 15.51 | 12.28 | 14.73 | 22.75 | 28.89 |
| June..... | 6.97 | 13.80 | 14.40 | 14.05 | 14.92 | 21.53 | 30.23 |
| July..... | 7.86 | 13.53 | 14.36 | 14.40 | 17.39 | 21.53 | 30.88 |
| August..... | 8.34 | 12.99 | 14.68 | 15.01 | 17.17 | 21.87 | 31.25 |
| September..... | 8.01 | 12.77 | 15.24 | 14.02 | 17.21 | 22.48 | 31.37 |
| October..... | 7.75 | 11.02 | 14.83 | 13.10 | 16.80 | 21.96 | 31.07 |
| November..... | 7.14 | 10.52 | 13.92 | 12.68 | 16.30 | 21.53 | ..... |

[a]With the exception of 1925 and 1928, for which data are not available. Data furnished by the Departments of Agronomy and Agricultural Engineering, University of Illinois. [b]Weighed at end of month.

or even more. Corn cribbed in December, 1924, having an exceptionally high percentage of moisture (42.9 percent) shrank 30 percent by the following June.

When the data in Table 7 are used to estimate the probable shrinkage of ear corn in storage in a given year, a column of data for a year when conditions were like those in the year under consideration should be chosen. If the corn is well matured and has had a good chance to dry in the field, the probable shrinkage is best indicated by the data on the corn stored in November of 1924 or 1927, or in December, 1929. If the corn is especially well matured and dry, then the data for 1930 should be used. If it is not well matured or well dried, then the data for the corn stored in December of 1926 or 1927 will give a fairly close indication of the shrinkage to be expected. The closest estimates can usually be made when the corn is tested for moisture at the time it is cribbed, for it is then a simple matter to decide which column of data from Table 7 should be used in making the estimate.

After the probable shrinkage is estimated, the question must still be answered whether the shrinkage should be considered a storage cost. When ear corn is sold on the basis of its shelled-corn grade, the

question is: *Does the improvement in grade raise the price enough to offset the loss in number of bushels?*

Assume the following conditions: (*a*) 75 pounds taken as the weight of a bushel of ear corn at harvest, and 70 pounds taken as the weight in March; (*b*) moisture content of the shelled corn, 20 percent at harvest and 15 percent in March; (*c*) shrinkage of 10 percent in weight; (*d*) a 50-cent price-level; and (*e*) a price scale of ½ cent difference for each ½-percent difference in moisture. Under these conditions:

1. At harvest, 75,000 pounds of corn equals 1,000 bushels at 75 pounds a bushel. At 50 cents a bushel the value is $500.

2. In March, after 10-percent shrinkage, 67,500 pounds would remain, which at 70 pounds to the bushel would equal 964 bushels. At 55 cents a bushel the value would be $530.

In this case the increase in price due to improved grade would more than offset the shrinkage in weight.

**Corn to be sold on ear and not graded.** If ear corn is sold without regard to grade, shrinkage must be considered a direct item in storage cost. In order to allow for differences in moisture content, the weight taken to be a bushel is often varied at different seasons. The weights during different months equivalent to 70, 75, and 80 pounds at harvest time, assuming the average shrinkage shown in Table 6, are given in Table 8.

The amount of shrinkage that must be counted as a cost, assuming average shrinkage, can be determined by using Table 8. If, for ex-

TABLE 8.—LATER WEIGHTS OF EAR CORN EQUIVALENT TO 70, 75, AND 80 POUNDS AT HARVEST, ASSUMING AVERAGE 1903–1913 SHRINKAGE, AS SHOWN IN TABLE 6[a]

| Month | Weight at end of indicated month when weight at harvest was— | | | Shrinkage |
|---|---|---|---|---|
| | 70 pounds | 75 pounds | 80 pounds | |
| | *lb.* | *lb.* | *lb.* | *perct.* |
| December | 67.7 | 72.5 | 77.4 | 3.3 |
| January | 67.1 | 71.9 | 76.6 | 4.2 |
| February | 66.2 | 70.9 | 75.6 | 5.5 |
| March | 65.1 | 69.8 | 74.4 | 7.0 |
| April | 63.0 | 67.5 | 72.0 | 10.0 |
| May | 60.8 | 65.2 | 69.5 | 13.1 |
| June | 59.3 | 63.5 | 67.8 | 15.3 |
| July | 58.7 | 62.9 | 67.0 | 16.2 |
| August | 58.4 | 62.6 | 66.7 | 16.6 |

[a]These figures are based on shrinkage percentages computed in a period when corn was usually cribbed with a higher moisture content than is common now. Hence the figures must be taken as merely illustrative of how similar computations can be made for any percentage of shrinkage.

ample, 80 pounds is taken as a bushel of ear corn sold direct from the field and 70 pounds is taken as a bushel during the next August, the 70 pounds in August will be 3.3 pounds more than the equivalent of 80 pounds at harvest—which equivalent is 66.7 pounds if the shrinkage is average. Hence a loss in number of bushels equal to $3.3 \div 70$, or 4.7 percent, must be counted in figuring storage costs. With a 50-cent price-level, this loss in number of bushels is equivalent to 2.4 cents a bushel. Similar ratios can be figured for other months by using the figures in Table 8.

The above calculations are based on averages, but the figure to be used in any given year will depend on the amount of moisture in the corn when cribbed. When the moisture is so high that there is 20-percent shrinkage, 80 pounds of corn at harvest is equivalent to only 64 pounds when the corn is dried out. If 70 pounds is then taken as a bushel, the loss in bushels in storage would be $6 \div 70$, or 8.6 percent. With 15-percent shrinkage, 80 pounds is equivalent to 68 pounds, and the loss in number of bushels sold would be $2 \div 70$, or 2.9 percent. If the shrinkage in gross weight is 12.5 percent, no loss in bushels occurs if 80 pounds is taken for a bushel at harvest time and 70 pounds when the corn is dried out.

**Equivalent weights of shelled and ear corn.** What the equivalent weights are of shelled corn and ear corn is a question that farmers have been asking since the early days of the Illinois Station. The answer is that they vary greatly with time of year, moisture content, and various other factors. The only accurate way for a farmer to determine the equivalent weights for any lot of corn is to shell out an adequate sample and compare the weights before shelling and after shelling. For example, if 100 pounds of ear corn yields 70 pounds of shelled corn, the weight of ear corn equivalent to 56 pounds of shelled corn is obtained by dividing 56 by 70 and multiplying by 100, ($56 \div 70 = .80$; $.80 \times 100 = 80$ pounds).

## EXAMPLES OF FIGURING STORAGE COSTS

**Example 1: Shelled corn.** If 1,000 bushels of corn, originally containing 21 percent moisture, dries down until the moisture is 13 percent, 908 bushels will be left (Table 5). At 60 cents a bushel for corn containing 17.5-percent moisture, and with a price scale of ½ cent for each ½-percent difference in moisture, corn having 21 percent moisture would be worth 56.5 cents a bushel, and the 1,000 bushels would be worth $565. To be of equal value, the 908 bushels

left after drying would have to bring 62.2 cents a bushel ($565 ÷ 908 = 62.2 cents). Interest, insurance, and taxes must then be added to arrive at price needed to cover full cost of storage.

| | *Cents* |
|---|---|
| Price needed to allow for shrinkage | 62.2 |
| Interest at 6 percent for eight months | 2.4 |
| Insurance for eight months | .6 |
| Taxes | .4 |
| Price needed to cover storage costs | 65.6 |

Thus 65.6 cents a bushel for corn having 13 percent moisture is equivalent to 56.5 cents for corn having 21 percent moisture eight months earlier, if no allowance is made for providing storage space. The 8-cent increase in price, which should accompany the decline in moisture content from 21 to 13 percent, covers a large part of the 9.1 cents needed to compensate for shrinkage, interest, insurance, and taxes.

**Example 2: Ear corn sold at 70 pounds to bushel.** Assume that new corn is selling in November for 60 cents per 70-pound bushel in a year when the moisture content of corn going into storage is such that shrinkage by July will amount to about 18 percent. *What price must be obtained in July to offset the costs incurred?* Subtracting .18 from 1.00 leaves .82. Sixty cents (price obtainable at husking time) divided by .82 equals price which will offset the shrinkage, or 73.2 cents a bushel. To this amount must be added interest, insurance, and taxes.

| | *Cents* |
|---|---|
| Price necessary to allow for shrinkage | 73.2 |
| Interest at 6 percent for eight months | 2.4 |
| Insurance for eight months | .6 |
| Taxes | .4 |
| Price needed to cover storage costs | 76.6 |

Under the stated conditions 77 cents a bushel in July is equivalent to 60 cents a bushel the preceding November. Obviously figuring corn at the same weight per bushel in November and July is a very poor basis on which to sell corn.

**Example 3: Ear corn, 75 pounds a bushel at harvest, 70 pounds the next summer.** If 75 pounds of corn is taken to be a bushel in November, and 70 pounds the following summer, the increase in price required to offset storage charges need not be so large. If 1,000 bushels (75,000 pounds) of ear corn at husking time is held over, and if the shrinkage amounts to 18 percent (as in Example 2), 879 bushels at 70 pounds a bushel will be left for sale the following summer. The bushel shrinkage is thus 12.1 percent from November to

July. The price in July needed to cover shrinkage and other storage costs will then be arrived at as follows:

| | *Cents* |
|---|---|
| Price needed to allow for shrinkage | 68.3 |
| Interest at 6 percent for eight months | 2.4 |
| Insurance for eight months | .6 |
| Taxes | .4 |
| Price needed to cover storage costs | 71.7 |

Thus 72 cents a bushel in July is equivalent to 60 cents in November under the stated conditions.

**Example 4: Ear corn sold according to its grade as shelled corn.** The costs of holding ear corn to be sold according to its grade as shelled corn are the same as for holding corn to be sold without reference to grade except that when the corn is sold by grade any improvement during storage will in part offset the costs of storage.

Suppose corn of rather high moisture content, 23 percent, goes into storage in November. If the following summer it is sound and is dried down to 15 percent moisture, it should grade No. 2. If the price at harvest is 60 cents for corn having 23 percent moisture, the equivalent price for No. 2 corn would be 68 cents. A rise of only 8 cents if 70 pounds is considered to be a bushel in November, or of only 4 cents if 75 pounds is so considered (Examples 2 and 3), would be needed to cover the storage costs if the bushel-weight in July is 70 pounds. The bettering of the grade makes up the rest of the difference between equivalent November and July prices.

## OTHER CONSIDERATIONS IN STORING CORN

Other factors besides costs and shrinkage should be considered in deciding whether and how long to store corn. It may be important to market the corn at a time when field work is not hindered thereby, altho the greater use of motor trucks in hauling corn makes such conflicts for labor and time less important than formerly. Road conditions must also be considered, altho the trend toward improved roads makes this factor likewise less important than formerly for many farmers.

High amount of moisture is not the only factor that reduces the grade of corn (Table 4). Appreciable damage during storage will hold down the grade, even tho moisture content has been reduced, and may prevent the improvements in price that usually accompanies loss in moisture.

Insect damage to stored corn is considerable in southern Illinois

and is often an important problem in central and northern Illinois. Losses from rats and other rodents may be serious; altho if cribs are properly built and other precautions are taken, such losses will be small.

## EARNINGS FROM HEDGED AND UNHEDGED CORN

Many grain merchants, by sale of future contracts, customarily hedge the price risk on grain they have stored, a practice that limits the possibilities either of loss or of gain from price changes. Farmers who have enough grain in storage to make it worth-while could follow the same practice, altho they rarely do so, probably because they expect to profit from a rise in price during the storage period and are willing to absorb such loss as would occur should the price decline. The possible loss to a farmer is usually smaller in relation to his total capital than is the possible loss to a grain merchant in relation to his capital.

Furthermore farmers who are considering the advisability of hedging stored grain should remember that because hedging is a device primarily for protection against loss it operates at the same time to limit the possibility of profit from advancing prices. When the purpose of storage is to secure the advantage of *probable* price advances, and when the risk in relation to total capital is not large, it would hardly be an advantage to hedge. As a matter of fact, according to the data presented below, corn stored from harvest to the following summer has returned more profit, on the average, when not hedged than when hedged. The situation is somewhat different with soft wheat and oats, as will be brought out later.

The technic of hedging in connection with storage is as follows: Whenever grain is purchased for storage an equivalent quantity of futures is sold; when the grain is sold, the futures are purchased. The earnings from these transactions equal the sum of the discount of the price of cash corn under the price of futures at the time when the cash corn is bought, plus any premium in the price of cash corn over the price of futures when cash corn is sold. Two pairs of transactions thus affect the result. Costs of storage and of hedging are omitted from these calculations. In actual practice, of course, earnings from hedging are reduced by the necessary costs of handling the future transactions. However, since these costs may vary so much with individuals, depending upon whether they are Exchange members or not, and from one time to another, depending upon the amount of margins, they have been omitted in these comparisons.

For the sixteen crop years 1921-22 to 1936-37 the average of the lows of the daily quotations on the Chicago market for contract grades of corn on the 5th, 10th, 15th, 20th, 25th, and 30th days (or on the next business day) of December, April, and July were computed. Averages were also computed of the range in the price of the May

TABLE 9.—DESIGNATED CASH AND FUTURE PRICES FOR CORN ON CHICAGO MARKET IN PERIODS INDICATED[a]

| Marketing year | Price of contract grade in— | | | May future in— | | July future in— | |
|---|---|---|---|---|---|---|---|
| | December | April | July | December | April | April | July |
| | *cents* | *cents* | *cents* | *cents* | *cents* | *cents* | *cents* |
| 1921–22 | 48.3 | 59.5 | 63.8 | 53.8 | 60.2 | 63.9 | 62.4 |
| 1922–23 | 73.4 | 80.2 | 85.1 | 72.1 | 78.7 | 80.8 | 83.8 |
| 1923–24 | 72.4 | 78.8 | 107.8 | 73.9 | 77.3 | 78.5 | 105.6 |
| 1924–25 | 124.6 | 106.4 | 105.0 | 128.4 | 105.6 | 109.4 | 102.3 |
| 1925–26 | 80.4 | 73.1 | 80.3 | 84.7 | 72.3 | 76.6 | 75.0 |
| 1926–27 | 74.5 | 72.8 | 102.0 | 82.0 | 71.7 | 77.0 | 99.6 |
| 1927–28 | 88.6 | 105.5 | 107.2 | 92.6 | 103.5 | 106.7 | 106.9 |
| 1928–29 | 84.5 | 91.8 | 99.9 | 90.2 | 91.2 | 94.7 | 98.6 |
| 1929–30 | 90.7 | 82.5 | 81.8 | 96.5 | 83.0 | 85.1 | 80.9 |
| 1930–31 | 71.0 | 58.3 | 58.7 | 74.0 | 59.5 | 61.4 | 59.9 |
| 1931–32 | 38.0 | 32.6 | 31.5 | 40.8 | 32.8 | 36.2 | 30.1 |
| 1932–33 | 24.3 | 35.1 | 53.1 | 27.1 | 34.0 | 36.2 | 55.4 |
| 1933–34 | 47.0 | 45.9 | 63.3 | 51.3 | 45.9 | 48.5 | 61.3 |
| 1934–35 | 96.0 | 90.5 | 85.3 | 89.5 | 88.2 | 82.5 | 82.5 |
| 1935–36 | 61.9 | 63.8 | 88.9 | 59.6 | 61.9 | 60.9 | 84.4 |
| 1936–37 | 111.0 | 138.6 | 118.4 | 104.1 | 128.1 | 118.7 | 122.4 |

[a]Future prices are based on averages for 5th, 10th, 15th, 25th, or 30th day of the month, or for next business day if any of those days was not a business day. These averages are taken from yearly numbers of *Annual Report of the Trade and Commerce of Chicago*, published by the Chicago Board of Trade. Cash prices are the average of reported lows of the quotations for contract grades on the same days.

future on the same days in December and April; and of the price of the July future on the same days in April and July. These averages are listed in Table 9. The low of the cash quotations for contract grade was used in order to eliminate the influence of variation in quality within the grade; the average of the future prices was used because the price of futures always refers to the contract grade, and therefore variations in future prices reflect only differences in time. Actually the hedger would not trade at the average prices found in Table 9 but would try to select times for purchase or sale when differences between cash and future prices would be more favorable to him. However, if data from actual transactions were available, the earnings from hedged and unhedged corn in these particular years would probably not vary significantly from the final averages shown in Table 10.

**December to April.** For the sixteen crop years 1921-22 to 1936-37 the average increase in the calculated cash price of corn between December and April was 1.7 cents; the number of years with increases

TABLE 10.—APPARENT EARNINGS FROM STORING CORN FROM DECEMBER TO APRIL AND FROM DECEMBER TO JULY, HEDGED AND UNHEDGED, CHICAGO PRICES, 1921–1937[a]

| Marketing year | Increase in price of cash corn from December to April | May future over December cash in December | April cash over May future in April | Apparent earnings from storing, December to April, hedged | Increase in price of cash corn from December to April | July future over April cash in April | July cash over July future in July | Apparent earnings from storing, December to July, hedged |
|---|---|---|---|---|---|---|---|---|
| | *cents* | *cents* | *cents* | *cents* | *cents* | *cents* | *cents* | *cents* |
| 1921–22 | +11.2 | +5.5 | −.7 | +4.8 | +15.5 | +4.4 | +1.4 | +10.6 |
| 1922–23 | +6.8 | −1.3 | +1.5 | +.2 | +11.7 | +.6 | +1.3 | +2.1 |
| 1923–24 | +6.4 | +1.5 | +1.5 | +3.0 | +35.4 | −.3 | +2.2 | +4.9 |
| 1924–25 | −18.2 | +3.8 | +.8 | +4.6 | −19.6 | +3.0 | +2.7 | +10.3 |
| 1925–26 | −7.3 | +4.3 | +.8 | +5.1 | −.1 | +3.5 | +5.3 | +13.9 |
| 1926–27 | −1.7 | +7.5 | +1.1 | +8.6 | +27.5 | +4.2 | +2.4 | +15.2 |
| 1927–28 | +16.9 | +4.0 | +2.0 | +6.0 | +18.6 | +1.2 | +.3 | +7.5 |
| 1928–29 | +5.9 | +4.3 | +.6 | +4.9 | +14.0 | +2.9 | +1.3 | +9.1 |
| 1929–30 | −8.2 | +5.8 | −.5 | +5.3 | −8.9 | +2.6 | +.9 | +8.8 |
| 1930–31 | −12.7 | +3.0 | −1.2 | +1.8 | −12.3 | +3.1 | −1.2 | +3.7 |
| 1931–32 | −5.4 | +2.8 | −.2 | +2.6 | −6.5 | +3.6 | +1.4 | +7.6 |
| 1932–33 | +10.8 | +2.8 | +1.1 | +3.9 | +28.8 | +1.1 | −2.3 | +2.7 |
| 1933–34 | −1.1 | +4.3 | 0.0 | +4.3 | +16.3 | +2.6 | +2.0 | +8.9 |
| 1934–35 | −5.5 | −6.5 | +2.3 | −4.2 | −10.7 | −8.0 | +2.8 | −9.4 |
| 1935–36 | +1.9 | −2.3 | +1.9 | −.4 | +27.0 | −2.9 | +4.5 | +1.2 |
| 1936–37 | +27.6 | −6.9 | +10.5 | +3.6 | +7.4 | −19.9 | −4.0 | −20.3 |
| Average, 1921–1937 | +1.7 | +2.0 | +1.4 | +3.4 | +9.0 | +.1 | +1.3 | +4.8 |

[a]See footnote for Table 9 on opposite page.

and decreases were equal (Table 10). This increase of 1.7 cents represented the average amount which would have been earned by storing a bushel of corn from December to April each year without hedging, using average prices as calculated above.

If the corn had been hedged, the average margin would have been 3.4 cents. Of this, the discount of the cash price under the future in December accounted for 2.0 cents, and the premium of the cash price over the future in April accounted for 1.4 cents. If the corn were hedged, losses would have been sustained in only two of the sixteen years, 1934-35 and 1935-36, even tho cash corn in December was not at a discount under the May future in four of the sixteen years, and cash corn in April was not at a premium over the May future in the four years when there were drastic declines in price—1921, 1930, 1931, and 1932.

Obviously it paid better to hedge corn stored from December to April than to carry it unhedged, for the margin was about twice as large and was also more stable. When corn was stored unhedged, annual gross earnings per bushel ranged from 18.2 cents loss to 27.6 cents gain; when it was hedged, the range was from 4.2 cents loss to 8.6 cents gain.

**December to July.** For corn stored from December to July the situation was different. Between these months the average increase in the cash price was greater than the margin that would probably have been earned by hedging, *9.0 cents compared with 4.8 cents.* The margin that could have been earned by carrying hedged grain from December to July was calculated by adding to the margin earned by carrying the grain from December to April: (*a*) the discount of the cash price under the July future in April, and (*b*) the premium of cash price over the July future in July. This calculation assumed that the hedge was shifted in April by purchase of May futures and simultaneous sale of July futures, and that the deal was completed in July by purchase of July futures and sale of cash corn.

By storing cash corn unhedged from December to July, gains would have been realized in ten years and losses in six. If the corn had been hedged, there would have been gains in fourteen years and losses in two. Not counting the two drouth years, 1934-35 and 1936-37, the average gains would have been 10.5 cents if the corn had been stored without hedging and 7.6 cents if it had been hedged. It if had been hedged, the calculated gains in the different years would have varied from 1.2 cents to 15.2 cents; if it had been unhedged, the margins would have varied from 19.6 cents loss to 35.4 cents gain.

**Earnings from hedging affected by seasonal price trend.** On corn stored from December to April, a period when the seasonal price increase was typically small, average returns were greater as well as more uniform when the corn was hedged. During April thru July the price of both cash grain and future contracts typically advances. The holder of unhedged grain gets the full benefit from this advance, while the holder of hedged grain gains only the difference between the cash price and the price of the future. Therefore on corn stored from December to July, a period when the seasonal price increase was typically large, returns averaged greater year in and year out altho they were more irregular when the corn was not hedged. These facts suggest that, in general, hedging tends to increase earnings from storage of corn during months when little seasonal price advance is likely but to reduce earnings on storage during months in which there is a large seasonal advance in price.

## WHEN TO MARKET WHEAT

The general custom of farmers to market wheat at harvest rather than to hold it for a higher price reflects the widespread opinion that costs of storage and risks of deterioration are too high to be offset by any anticipated rise in price. So far as it applies to hard winter wheat, this opinion is in general borne out by records of prices and data on storage costs, but it is not so true of soft wheat grown principally in southern and southwestern Illinois.

### SALES TRENDS DURING MARKETING YEAR

About one-third of the wheat grown in Illinois is, on the average, held in storage by farmers beyond October 1, and about one-fifth is held beyond January 1. The proportion stored is higher in the upland sections of the counties southeast of St. Louis than in other parts of Illinois. Probably about two-fifths of the crop in that section is held by farmers up to October 1, and about one-third is held beyond January 1. These conclusions are based on the following series of data:

1. According to annual estimates by the Illinois Cooperative Crop Reporting Service,[1] the quantity of wheat on farms during the eleven marketing years 1927-28 to 1937-38 averaged slightly more than one-third of the previous crop and carryover on October 1, the proportion from year to

[1] *Illinois Crop and Livestock Statistics*, Illinois Cooperative Crop Reporting Service, Illinois Department of Agriculture cooperating with the U. S. Department of Agriculture.

TABLE 11.—ILLINOIS WHEAT: PERCENTAGE OF PREVIOUS CROP AND CARRYOVER ON FARMS ON DESIGNATED DATES, 1927–1937 CROPS

| Marketing year | Size of crop | Current crop plus July 1 carryover | Portion of previous crop and carryover still on farms on— | | | |
|---|---|---|---|---|---|---|
| | | | October 1 | January 1 | April 1 | July 1 |
| | *1,000 bu.* | *1,000 bu.* | *perct.* | *perct.* | *perct.* | *perct.* |
| 1927–28 | 34 091 | 34 952 | 28.3 | 14.6 | 5.9 | 1.9 |
| 1928–29 | 23 264 | 23 946 | 35.9 | 23.3 | 12.6 | 3.9 |
| 1929–30 | 30 831 | 31 762 | 31.1 | 21.4 | 8.7 | 2.9 |
| 1930–31 | 36 891 | 37 816 | 33.2 | 26.3 | 8.8 | 2.0 |
| 1931–32 | 48 945 | 49 683 | 41.4 | 30.5 | 15.8 | 5.9 |
| 1932–33 | 25 983 | 28 920 | 48.5 | 25.2 | 20.7 | 6.7 |
| 1933–34 | 30 746 | 32 695 | 42.3 | 21.6 | 13.2 | 5.6 |
| 1934–35 | 36 522 | 38 367 | 37.1 | 21.9 | 13.3 | 5.7 |
| 1935–36 | 30 060 | 32 251 | 31.7 | 14.9 | 7.5 | 2.8 |
| 1936–37 | 36 435 | 37 337 | 28.3 | 11.7 | 5.4 | 2.9 |
| 1937–38 | 45 724 | 46 817 | 31.3 | 20.5 | 12.7 | 5.9 |
| Average, 1927–1937 | ..... | ..... | 35.4 | 21.1 | 11.3 | 4.2 |

year ranging from 28 percent in 1936 to 48 percent in 1932 (Table 11). On the following January 1 about one-fifth of the crop and carryover remained on farms; on April 1, about 11 percent; and at the end of the marketing year, or July 1, about 4 percent.

**2.** About 70 percent of the grain of the 1923-1925 crops shipped by a considerable group of Illinois elevators (mainly in central and northern Illinois) was moved by October 1; 85 percent by January 1; 93 percent by April 1, and only about 7 percent during the last three months of the marketing year.[1]

**3.** According to a survey of 97 country mills and elevators in southern Illinois, 72 percent of the grain in 1937-38 was purchased from July 1 to October 1, 79 percent by January 1, and 89 percent by April 1, leaving 11 percent for the last three months of the marketing year.[2] In the upland sections of counties southeast of St. Louis (Monroe, St. Clair, Clinton, Washington, and Randolph) wheat was marketed more slowly than in other wheat-growing areas.

In view of these very large proportions of the wheat crops marketed early in the marketing year, the question as to whether, on the average, it pays farmers to store wheat is of considerable importance in some sections of Illinois.

## TYPICAL PRICE CHANGES

### Soft Red Winter Wheat

Whether it pays to hold any commodity depends, of course, on the relation between price changes during the storage period and the costs involved. For the seventeen marketing years 1921-1937, average

[1] Ill. Agr. Exp. Sta. Bul. 324. 1929.

[2] Ill. Agr. Exp. Sta. mimeo. pub. AE-1104. 1939.

monthly prices of No. 2 soft red winter wheat at St. Louis averaged as follows:

| | | | | | |
|---|---|---|---|---|---|
| July | $1.11 | November | $1.15 | March | $1.19 |
| August | 1.11 | December | 1.18 | April | 1.19 |
| September | 1.14 | January | 1.22 | May | 1.18 |
| October | 1.15 | February | 1.21 | June | 1.13 |

The high price came most commonly in January and averaged 11 cents above the average for July and August (Fig. 3). During prewar years (1899-1913) prices increased an average of 12 cents from the July-August average to February, the high month in that period. This advance of 11 cents in 1921-1937 and of 12 cents in 1899-1913 was the average amount realized from storing one bushel of wheat each year to cover payment for cost of binning, storage space, interest, insurance, risk of deterioration in quality, and shrinkage in quantity. These averages are not far from the cost figure suggested on page 34.

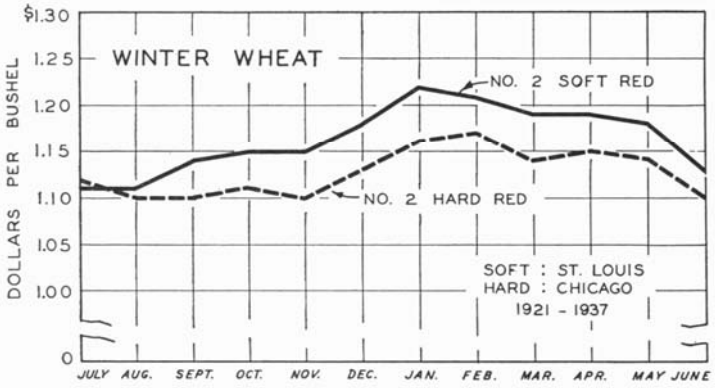


**Fig. 3.—Average monthly price for No. 2 soft red winter wheat at St. Louis and for No. 2 hard red winter wheat at Chicago, 1921-1937 crops**

The period from harvest to midwinter saw greater advances in the price of soft red winter wheat at St. Louis than in the price of hard red winter wheat at Chicago. January was the month of highest average price for soft wheat, February the month when hard wheat averaged highest.

The advance of wheat prices after harvest was not uniform from year to year (Table 12 and Fig. 4). In September, December, and January prices were typically higher than in the previous month. In these months there is but little crop news to change the level of the wheat market; whereas in July and August the price is dominated by news from the new North American and European crops; in October and November, by news from the new Argentine and Australian

crops. After February the price typically increases little or not at all, declines from one month to the next being more common than increases. Thus there seems to be little point in farmers holding soft wheat beyond February.

TABLE 12.—DIRECTION OF CHANGE IN PRICE FROM PREVIOUS MONTH: NO. 2 SOFT RED WINTER WHEAT AT ST. LOUIS AND NO. 2 HARD RED WINTER WHEAT AT CHICAGO, 1921–1937 CROPS

| Month | Average change from previous month | Number of years when price went— | | Average total change from August |
|---|---|---|---|---|
| | | Up | Down | |
| **Soft red winter wheat** | | | | |
| | *cents* | | | *cents* |
| July | −6 | 6 | 10 | ... |
| August | 0 | 9 | 7 | ... |
| September | +3 | 11 | 4 | +3 |
| October | +1 | 8 | 9 | +4 |
| November | 0 | 8 | 9 | +4 |
| December | +3 | 12 | 4 | +7 |
| January | +4 | 13 | 3 | +11 |
| February | −1 | 6 | 8 | +10 |
| March | −2 | 3 | 13 | +8 |
| April | 0 | 8 | 9 | +8 |
| May | −1 | 4 | 12 | +7 |
| June | −5 | 6 | 11 | +2 |
| **Hard red winter wheat** | | | | |
| July | −2 | 6 | 10 | ... |
| August | −2 | 7 | 9 | ... |
| September | 0 | 8 | 7 | 0 |
| October | +1 | 9 | 8 | 1 |
| November | −1 | 8 | 8 | 0 |
| December | +3 | 12 | 4 | 3 |
| January | +3 | 13 | 2 | 6 |
| February | +1 | 8 | 9 | 7 |
| March | −3 | 3 | 12 | 4 |
| April | +1 | 9 | 7 | 5 |
| May | −1 | 7 | 9 | 4 |
| June | −4 | 5 | 11 | 0 |

The foregoing variations in wheat prices, however, were those typical before Commodity Credit Corporation loans became a factor in the market. If these loans continue to be made, they are likely to modify the seasonal pattern of wheat prices by causing the rise to come a little earlier than is indicated here. Actually the seasonal rise occurred earlier in 1939-40 and 1940-41 even tho there were considerable quantities of wheat not eligible for government loans. However, farmers with wheat under loan may well consider the advisability of selling during the months when the price has been most consistently highest in the past, December and January, provided of course that they have an equity at this time.

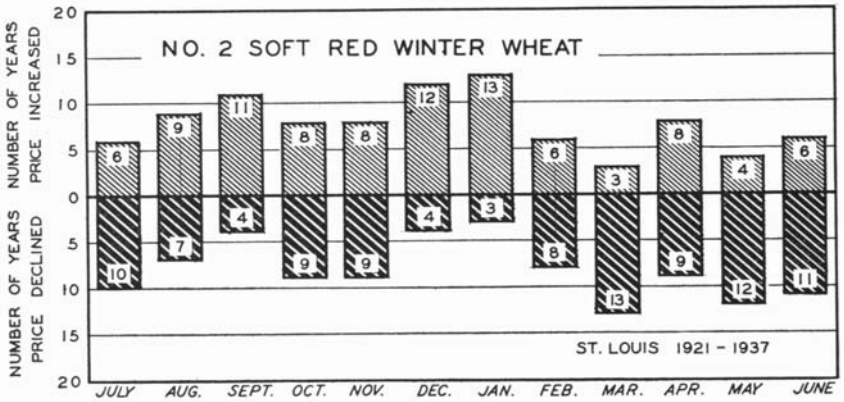


**Fig. 4.—Number of times during seventeen crop years that the monthly price of No. 2 soft red winter wheat at St. Louis was higher or lower than that of previous month, 1921-1937**

In September, December, and January the average monthly price of soft red winter wheat advanced beyond that of the previous month much more frequently than it declined. In July, March, May, and June it declined much more frequently than it advanced.

## Hard Red Winter Wheat

The price of hard winter wheat does not typically follow the same trend during the marketing season as the price of soft wheat (Fig. 3). The average increase during the marketing years 1921 to 1937 was not enough to justify farmers in storing this grain. And according to common observation, less wheat is stored in those sections of Illinois where hard wheat is grown (central and northern Illinois) than in those producing soft wheat.

Average monthly prices at Chicago for No. 2 hard winter wheat of the 1921-1937 crops were as follows:

| | | |
|---|---|---|
| July.....$1.12 | November.....$1.10 | March.....$1.14 |
| August..... 1.10 | December..... 1.13 | April..... 1.15 |
| September.... 1.10 | January..... 1.16 | May..... 1.14 |
| October..... 1.11 | February..... 1.17 | June..... 1.10 |

Thus prices remained, on the average, about the same from August to November; advanced from November to February, and declined from February to June. Between August and February the average increase was only 7 cents, whereas it was 11 cents for No. 2 soft red winter wheat at St. Louis. In Kansas City the seasonal pattern of the price of No. 2 hard winter wheat was similar to that at Chicago, increasing only from November to February and averaging 6 cents increase between August and February.

The direction of typical change in price of hard red winter wheat from one month to the next between August and November was not regular (Table 12 and Fig. 5). During these months conditions change in no regular seasonal pattern, because crop news is coming in from

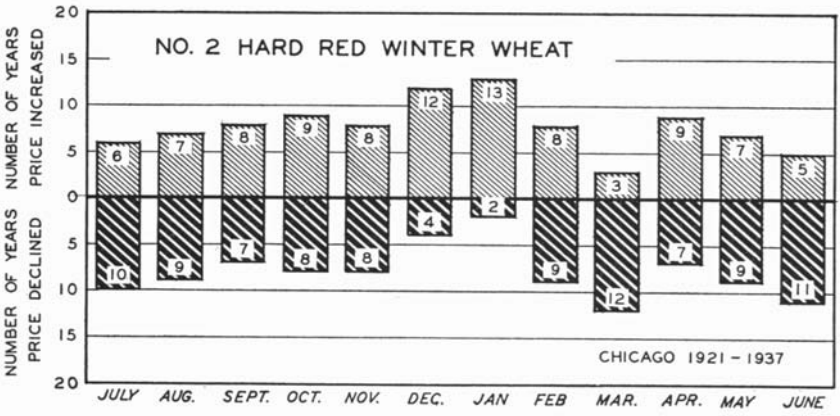


**Fig. 5.—Number of times during seventeen crop years that the monthly price of No. 2 hard red winter wheat at Chicago was higher or lower than that of previous month, 1921-1937**

In December and January the average monthly price of hard wheat advanced beyond that of the previous month much more frequently than it declined. In April it advanced in nine years and fell behind in seven. It more often fell below the previous month in July, March, and June.

the more northern parts of the United States, and from Canada, Europe, Australia, and Argentina. In December and January the price was more commonly above than below that of the previous month. After January the situation was quite erratic; declines from the previous months were more common than advances especially in March, June, and July. In the other months increases and decreases were about equally divided.

## ITEMS IN COST OF STORING WHEAT

Except that the provision of storage space for wheat must commonly be included as a cost, the items of cost for storing wheat are in general similar to those involved in the storing of corn.

**Interest and insurance.** These items are calculated for wheat in the same manner as for corn (pages 11 and 13).

**Taxes.** Since little wheat is carried until the assessment date, taxes can generally be ignored as an item of cost in storing wheat.

**Storage space.** Since wheat is commonly sold directly from the thresher or combine, no bin room need be provided at the farm unless the wheat is to be held in storage. The providing of space therefore represents a storage cost if the granary or other storage facility is built expressly for the purpose of storing wheat. If the cost of a granary for 1,000 bushels is $250, then the annual cost (interest, taxes, depreciation, upkeep) would be $25, or 2½ cents a bushel, assuming that the annual cost for these items equal 10 percent of the investment.

If, however, storage facilities are already available on the farm, the cost will be the same whether the space is used or not, and no charge for space need be made.

**Expense of binning.** Extra labor is involved in binning wheat, and later in loading it out of the bin. Likewise the cost of power and use of equipment must be considered if mechanical methods of unloading and elevating are used. If these operations require 3 hours of labor per 100 bushels and labor costs 30 cents an hour, the total labor cost would be about .9 cent a bushel. The labor item will of course vary according to such matters as the convenience of the arrangements for storage and the labor costs on the individual farm. Nine-tenths cent per bushel is therefore merely suggestive.

**Shrinkage and deterioration.** So far as grading is concerned, changes in amount of moisture in wheat are not so important as such changes are in corn. The grade specifications for soft red winter wheat are shown in Table 13, those for hard red winter wheat being similar except with respect to subclasses. No attention is paid to moisture in wheat if it is below 14.0 percent. Wheat of the classes grown in Illinois is designated as "tough" if the moisture content is between 14.1 and 15.5 percent, regardless of grade; and if the moisture is over 15.5 percent, the wheat is sample grade.

Shrinkage of wheat in storage cannot, however, be entirely disregarded. There is likely to be some slight shrinkage due to drying out, altho this sometimes improves the grade by raising the test weight. Also there is the hazard of loss from insect damage, rats, mice, and leaky bins, and the possibility of the wheat heating or getting musty. "Percent of damaged kernels" and "heat-damaged" kernels are grade factors. For example, .1 percent of heat-damaged kernels is the maximum allowed in No. 1 wheat. In recent years some wheat containing a high percentage of heat-damaged kernels, commonly designated as "sick wheat," has been condemned as unfit for milling and subjected to considerable discount.

Evaluation of all of these storage hazards is difficult because of

TABLE 13.—OFFICIAL GRAIN STANDARDS FOR SOFT RED WINTER WHEAT, AS OF 1940

| Grade No. | Minimum test weight per bushel | Maximum limits of— | | | | | |
|---|---|---|---|---|---|---|---|
| | | Damaged kernels (wheat and other grains) | | Foreign material | | Wheats of other classes | |
| | | Total | Heat-damaged | Total | Matter except other grains | Total | Durum and/or Red Durum |
| | *lb.* | *perct.* | *perct.* | *perct.* | *perct.* | *perct.* | *perct.* |
| 1[a] | 60 | 2 | .1 | 1 | .5 | 5 | .5 |
| 2[a] | 58 | 4 | .2 | 2 | 1.0 | 10 | 1.0 |
| 3[a] | 56 | 7 | .5 | 3 | 2.0 | 10 | 2.0 |
| 4 | 54 | 10 | 1.0 | 5 | 3.0 | 10 | 10.0 |
| 5 | 51 | 15 | 3.0 | 7 | 5.0 | 10 | 10.0 |
| Sample grade | Sample grade shall include wheat of the subclass Red Winter, or Western Red,[b] which does not come within the requirements of any of the grades from No. 1 to No. 5, inclusive; or which contains more than 15.5 percent of moisture; or which contains inseparable stones and/or cinders; or which is musty, or sour, or heating, or hot; or which has any commercially objectionable foreign odor except of smut or garlic; or which contains a quantity of smut so great that any one or more of the grade requirements cannot be applied accurately; or which is otherwise of distinctly low quality. | | | | | | |

[a]The wheat in grades No. 1 and No. 2 of this class may contain not more than 7 percent, and the wheat in grade No. 3 of this class may contain not more than 10 percent, of shrunken and/or broken kernels of grain and other matter that will pass through a 20-gage metal sieve with slotted perforations 0.064 inch wide by ⅜ inch long. [b]In hard red winter wheat different subclasses are involved.

the great variations in conditions from farm to farm, but under fairly good conditions shrinkage and other losses during six months' storage will probably amount to 2 to 5 percent. When wheat is a dollar a bushel, this loss represents a cost of 2 to 5 cents a bushel. Fumigation, which is generally necessary in southern and south-central Illinois,[1] will be an additional cost each year of about ½ cent a bushel.

**Total storage costs.** Taking into account the foregoing items, the total costs involved in storing a bushel of wheat for six months are about as follows:

| | *Cents* |
|---|---|
| Interest for six months on $1.00 wheat at 6 percent | 3 |
| Insurance for six months | 1 |
| Storage space (where it is a proper charge) | 2½ |
| Binning expense | 1 |
| Shrinkage and deterioration (2 to 5 percent) | 2–5 |
| Fumigation | ½ |
| Total storage costs | 10–13 |

If the storage space and labor required would otherwise be unused, they need not be counted as costs, in which case the total would be 6 to 9 cents a bushel.

[1]For methods of fumigating grains to protect them against insect damage see Circular 512, "How to Know and Control Stored-Grain Insects."

## EARNINGS FROM SOFT WHEAT HEDGED AND UNHEDGED

The preceding discussion of changes in prices of wheat during the marketing year (page 28) had to do with changes in *cash* prices. Grain dealers and millers, however, frequently hedge stored wheat by sale of futures. And farmers who have enough wheat may find it good business to do the same thing.

Earnings that could have been made from storing No. 2 soft red winter wheat during 1921 to 1937, both hedged and unhedged, were worked out on the basis of monthly average prices of cash wheat at St. Louis and monthly average prices of selected futures at Chicago. Soft wheat only was considered inasmuch as average changes in price of hard winter wheat have not warranted the storage of that class of wheat (page 31). Since wheat at St. Louis would probably be hedged by sale of futures at Chicago, this comparison is appropriate. Data based on prices of the 1921-1937 crops are given in Tables 14, 15, and 16.

**August to December.** From August to December over the seventeen-year period the average increase in the price of cash No. 2

TABLE 14.—APPARENT EARNINGS FROM STORING NO. 2 SOFT RED WINTER WHEAT FROM AUGUST TO DECEMBER, HEDGED AND UNHEDGED, ST. LOUIS PRICES, 1921–1937[a]

| Marketing year | Increase in price of cash wheat from August to December | December future in August over August cash | December cash over December future in December | Apparent earning from storing, August to December, hedged |
|---|---|---|---|---|
| | *cents* | *cents* | *cents* | *cents* |
| 1921–22 | −2 | 0 | +10 | +10 |
| 1922–23 | +27 | −5 | +13 | +8 |
| 1923–24 | +15 | +5 | +11 | +16 |
| 1924–25 | +41 | −6 | +10 | +4 |
| 1925–26 | +12 | −13 | +11 | −2 |
| 1926–27 | +3 | +6 | −2 | +4 |
| 1927–28 | +2 | +2 | +17 | +19 |
| 1928–29 | +1 | −21 | +24 | +3 |
| 1929–30 | +3 | +12 | +11 | +23 |
| 1930–31 | −6 | +6 | +6 | +12 |
| 1931–32 | +10 | +6 | +3 | +9 |
| 1932–33 | −7 | +3 | +2 | +5 |
| 1933–34 | −5 | +4 | +4 | +8 |
| 1934–35 | +3 | +5 | +4 | +9 |
| 1935–36 | +14 | −1 | +6 | +5 |
| 1936–37 | +18 | −6 | +3 | −3 |
| 1937–38 | −17 | −1 | 0 | −1 |
| Average, 1921–1937 | +6.6 | −.2 | +7.8 | +7.6 |
| Average, 1933–1937 | 2.6 | +.2 | +3.4 | +3.6 |

[a]Future prices are based on averages for 5th, 10th, 15th, 25th, or 30th day of the month, or for next business day if any of those days was not a business day. These averages are taken from yearly numbers of *Annual Report of the Trade and Commerce of Chicago,* published by the Chicago Board of Trade. Cash prices are monthly averages reported by the U. S. Department of Agriculture.

TABLE 15.—APPARENT EARNINGS FROM STORING NO. 2 SOFT RED WINTER WHEAT FROM AUGUST TO FEBRUARY, HEDGED AND UNHEDGED, ST. LOUIS PRICES, 1921–1937[a]

| Marketing year | Increase in price of cash wheat from August to February | Apparent earning from storing, August to December, hedged | May future in December over December cash | February cash over May future in February | Apparent earning from storing, August to February, hedged |
|---|---|---|---|---|---|
| | *cents* | *cents* | *cents* | *cents* | *cents* |
| 1921–22 | +15 | +10 | −6 | +2 | +6 |
| 1922–23 | +30 | +8 | −15 | +19 | +12 |
| 1923–24 | +19 | +16 | −5 | +7 | +18 |
| 1924–25 | +64 | +4 | −11 | +13 | +6 |
| 1925–26 | +13 | −2 | −14 | +17 | +1 |
| 1926–27 | +1 | +4 | −6 | −6 | −8 |
| 1927–28 | +14 | +19 | −12 | +24 | +31 |
| 1928–29 | +2 | +3 | −17 | +10 | −4 |
| 1929–30 | −9 | +23 | −1 | +5 | +27 |
| 1930–31 | −10 | +12 | −2 | −3 | +7 |
| 1931–32 | +10 | +9 | 0 | −3 | +6 |
| 1932–33 | −4 | +5 | +1 | +2 | +8 |
| 1933–34 | −1 | +8 | −2 | +1 | +7 |
| 1934–35 | −3 | +9 | −3 | +1 | +7 |
| 1935–36 | +11 | +5 | −8 | +10 | +7 |
| 1936–37 | +26 | −3 | −7 | +10 | 0 |
| 1937–38 | −12 | −1 | −3 | +6 | +2 |
| Average, 1921–1937 | +9.8 | +7.6 | −6.6 | +6.8 | +7.8 |
| Average, 1933–1937 | +4.2 | +3.6 | −4.6 | +5.6 | +4.6 |

[a]See footnote for Table 14, page 35.

TABLE 16.—COMPARATIVE EARNINGS FROM STORING NO. 2 SOFT RED WINTER WHEAT FROM AUGUST TO APRIL, HEDGED AND UNHEDGED, ST. LOUIS PRICES, 1921–1937[a]

| Marketing year | Increase in price of cash wheat from August to April | Apparent earning from storing, August to December, hedged | May future in December over December cash | April cash over May future in April | Apparent earning from storing, August to April, hedged |
|---|---|---|---|---|---|
| | *cents* | *cents* | *cents* | *cents* | *cents* |
| 1921–22 | +18 | +10 | −6 | +3 | +7 |
| 1922–23 | +30 | +8 | −15 | +15 | +8 |
| 1923–24 | +14 | +16 | −5 | +10 | +21 |
| 1924–25 | +39 | +4 | −11 | +27 | +20 |
| 1925–26 | −1 | −2 | −14 | +10 | −6 |
| 1926–27 | −5 | +4 | −6 | −5 | −7 |
| 1927–28 | +54 | +19 | −12 | +43 | +50 |
| 1928–29 | −13 | +3 | −17 | +7 | −7 |
| 1929–30 | −15 | +23 | −1 | +8 | +30 |
| 1930–31 | −9 | +12 | −2 | −2 | +8 |
| 1931–32 | +10 | +9 | 0 | 0 | +9 |
| 1932–33 | +16 | +5 | +1 | +7 | +13 |
| 1933–34 | −9 | +8 | −2 | +1 | +7 |
| 1934–35 | −4 | +9 | −3 | −1 | +5 |
| 1935–36 | +15 | +5 | −8 | +9 | +6 |
| 1936–37 | +27 | −3 | −7 | +8 | −2 |
| 1937–38 | −27 | −1 | −3 | +2 | −2 |
| Average, 1921–1937 | +8.2 | +7.6 | −6.6 | +8.4 | +9.4 |
| Average, 1933–1937 | +.4 | +3.6 | −4.6 | +3.8 | +2.8 |

[a]See footnote for Table 14, page 35.

soft red winter wheat was 6.6 cents a bushel. Increases occurred in twelve years and decreases in five, the largest decline (17 cents) occurring in 1937-38. The average margin that might have been earned when wheat was hedged was 7.6 cents a bushel, with gains in fourteen years and losses in three, ranging from 23 cents gain to 3 cents loss. This hedging margin was based almost entirely on the premium in December on cash wheat, which averaged 7.8 cents and developed in fifteen of the seventeen years. On the average, cash wheat in August sold at a slight premium over the December future, altho such premiums developed in only six of the seventeen years.

**August to February.** From August to February the cash price for No. 2 soft red winter wheat increased 9.8 cents as an average over the seventeen years; and an average of 7.8 cents could have been earned by hedging, assuming the following transactions: the December future was sold in August when the cash wheat was bought for storage; the December future was bought back and the May future sold in December, and the May future purchased in February when the cash wheat was sold. The cash price increased between August and February in eleven years and declined in six; and in the calculated hedging margin, gains would have resulted in fourteen years, losses in two, and no margin in one. The margins were much more uniform for grain that was hedged than for grain that was unhedged.

**August to April.** Over the seventeen years the cash price for No. 2 soft red winter wheat increased on the average 8.2 cents from August to April, and the margin that could be earned by hedging was 9.4 cents. The cash price increased in nine years and declined in eight, with one large gain in 1927-28. Hedging transactions would have yielded gains in twelve years and losses in five.

**Hedging makes earnings more stable.** The general conclusion can be drawn that the average earnings that could have been realized by storing soft wheat at St. Louis during this seventeen-year period would not have been greatly affected by hedging. For the August-to-December period the bushel margin when wheat was hedged was 7.6 cents, compared with 6.6 cents when it was not hedged; for the August-to-February period it was 7.8 cents when hedged and 9.8 cents when not hedged; and for the August-to-April period it was 9.4 cents when hedged and 8.2 cents when unhedged. Earnings were more stable, however, when the grain was hedged, altho even then they varied considerably. This variation in earnings on hedged wheat reflects the tendency at times for the price of this class of wheat

to deviate considerably from the price of the future. In February, 1928, for example, No. 2 red wheat at St. Louis sold at 24 cents over the May future; and in February, both in 1936 and in 1937, it sold at 10 cents above.

From 1933 to 1937, a period when the average earnings from storage of wheat were unsatisfactory, the earnings averaged better on hedged than on unhedged soft wheat. For August to December the bushel margin was 3.6 cents when the wheat was hedged, compared with 2.6 cents when it was not hedged; for August to February, it was 4.6 cents hedged and 4.2 cents unhedged; and for August to April, 2.8 cents hedged and .4 cent unhedged.

## WHEN TO MARKET OATS

Oats are extensively stored by farmers, not only for use as feed on the farm where grown, but also to gain the benefit of a possible rise in price. Average price rises during the marketing season, however, just about equal the costs of storage.

### SALES TRENDS IN MARKETING YEAR

Only about one-third of the Illinois oats crop and carryover is sold or fed on farms up to October 1 (Table 17). During the seventeen years 1921-1937, about half the crop and carryover (53 percent), as an average, still remained on farms on January 1. Disposal by farmers was lightest in the October-December quarter, probably because of the

TABLE 17.—ILLINOIS OATS: PERCENTAGE OF PREVIOUS CROP AND CARRYOVER ON FARMS ON DESIGNATED DATES, 1927–1937 CROPS

| Marketing year | Size of crop | Current crop plus July 1 carryover | Percentage of previous crop and carryover still on farms on— | | | |
|---|---|---|---|---|---|---|
| | | | October 1 | January 1 | April 1 | July 1 |
| | *1,000 bu.* | *1,000 bu.* | | | | |
| 1927–28 | 102 204 | 117 585 | 62.6 | 46.9 | 17.4 | 4.3 |
| 1928–29 | 168 338 | 173 448 | 67.9 | 52.4 | 27.2 | 9.7 |
| 1929–30 | 136 144 | 152 978 | 60.5 | 48.1 | 25.8 | 8.9 |
| 1930–31 | 144 318 | 157 932 | 63.1 | 50.3 | 27.4 | 9.1 |
| 1931–32 | 146 472 | 160 904 | 68.3 | 57.3 | 31.0 | 10.9 |
| 1932–33 | 164 775 | 182 352 | 63.3 | 56.0 | 32.5 | 14.5 |
| 1933–34 | 79 980 | 106 344 | 60.9 | 45.9 | 27.8 | 10.5 |
| 1934–35 | 38 883 | 50 080 | 76.1 | 59.0 | 40.4 | 12.4 |
| 1935–36 | 106 372 | 112 593 | 71.8 | 59.5 | 36.8 | 18.0 |
| 1936–37 | 99 608 | 119 819 | 63.2 | 46.6 | 27.4 | 7.5 |
| 1937–38 | 162 208 | 171 173 | 71.1 | 60.2 | 37.0 | 18.0 |
| Average, 1927–1937 | ..... | ..... | 66.2 | 52.9 | 30.1 | 11.3 |

availability of new corn, storage stocks in dealers' hands, and lighter demand for the feeding of work stock at that time. On April 1 only 30 percent remained, indicating the disposal of about one-fourth of the crop and carryover in the previous three months. At the end of June, the amount left on farms was 11 percent; thus the disposal from April to June was about one-fifth of the crop. Since at least one month is left after July 1 before the average date of threshing, the final carryover during these years was less than one-tenth of the combined crop and preceding carryover.

The proportion of the crop and the preceding carryover remaining on farms on July 1 varied from year to year, ranging from 4 percent in 1927-28 to 18 percent in 1935-36 and 1937-38. The carryover was higher in the last half of the period than in the first, averaging 9.6 percent from 1927-28 to 1932-33 and 13.3 percent from 1933-34 to 1937-38 in spite of the two drouth years 1934 and 1936. During 1934 to 1938 consumption of feed was lower than in the earlier period because of there being less livestock on farms, and this caused more oats to accumulate.

Elevator shipments of the 1923-1925 crops (the time of which varied somewhat from the time of sale by farmers, as elevators frequently store oats) were distributed by quarters as follows: July-September, 34 percent; October-December, 17 percent; January-March, 25 percent; April-June, 24 percent. The seasonal pattern of oat shipments was thus the same as for farm storage: about one-third of the movement occurring during and shortly after harvest, a slower movement developing in October to December, then a rather uniform movement taking place the rest of the year. Both series of data indicate extensive farm storage of oats.

## PRICE CHANGES DURING MARKETING YEAR

The average increase in price of oats during the marketing year is comparatively small, reflecting low storage costs (page 40). For the 1921-1937 crops the average monthly prices per bushel of No. 3 oats at Chicago were as follows:

| | | |
|---|---|---|
| August.....$.37 | December.....$.41 | April.....$.40 |
| September..... .38 | January..... .41 | May..... .40 |
| October..... .38 | February..... .41 | June..... .40 |
| November..... .39 | March..... .40 | July..... .39 |

The average increase from harvest to midwinter was thus 4 cents a bushel. After February the price declined. From harvest to January, except in October, increases from one month to the next were the rule;

TABLE 18.—DIRECTION OF CHANGE IN PRICE FROM PREVIOUS MONTH: No. 3 WHITE OATS AT CHICAGO, 1921–1937 CROPS

| Month | Average change from previous month | Number of years when price went— | | Average total change from August |
|---|---|---|---|---|
| | | Up | Down | |
| | *cents* | | | *cents* |
| August | −3 | 4 | 13 | 0 |
| September | +1 | 9 | 4 | +1 |
| October | 0 | 7 | 7 | +1 |
| November | +1 | 9 | 4 | +2 |
| December | +2 | 12 | 1 | +4 |
| January | 0 | 7 | 2 | +4 |
| February | 0 | 4 | 9 | +4 |
| March | −1 | 4 | 11 | +3 |
| April | 0 | 10 | 4 | +3 |
| May | 0 | 5 | 9 | +3 |
| June | 0 | 6 | 10 | +3 |
| July | −1 | 6 | 11 | +2 |

while from February to August decreases were more common, except in April (Table 18 and Fig. 6).

## ITEMS IN COST OF STORING OATS

The items entering into the cost of storing oats are similar to those involved in storing wheat (pages 32 to 34): interest, insurance, taxes (when storage extends beyond the assessment date), storage space, cost of binning, shrinkage, and risk of damage. Shrinkage and loss of quality are probably of less importance in the storing of oats than in the storing of wheat.

Total costs for storing a bushel of oats for eight months are approximately as follows:

| | *Cents* |
|---|---|
| Interest on 30-cent oats for eight months at 6 percent | 1.2 |
| Insurance on 30-cent oats for eight months | .3 |
| Storage space | 2.0 |
| Cost of binning | .5 |
| Shrinkage (2 percent) | .6 |
| Total storage costs | 4.6 |

The total cost is thus just about equal to the average rise in price of oats from harvest to midwinter, listed in the preceding section.

## EARNINGS FROM STORING OATS, HEDGED AND UNHEDGED

When oats in storage were hedged by sale of futures, the apparent earnings averaged greater than the seasonal differences in price listed in the foregoing section. Earnings in the sixteen marketing years

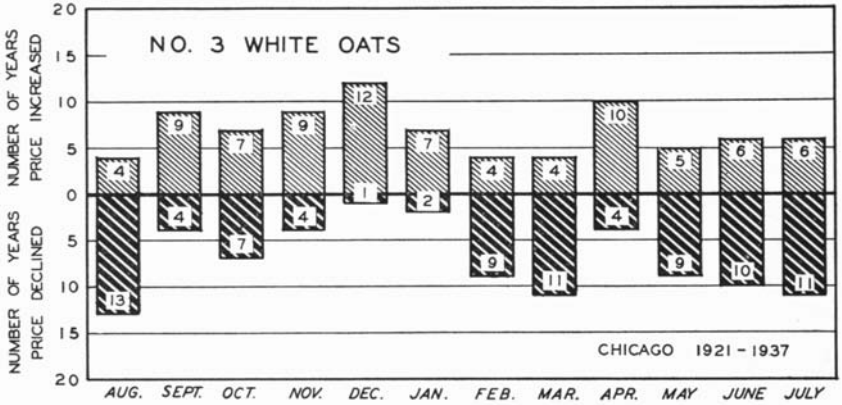


**Fig. 6.—Number of times during seventeen crop years that the monthly price of No. 3 white oats at Chicago was higher or lower than that of previous month, 1921-1937**

During five months—September, November, December, January, and April—the average monthly price of white oats advanced beyond that of the previous month more frequently than it declined. In six of the remaining seven months the price declined from the previous month much more frequently than it advanced.

1921-1936 (Table 19) are based on the purchase or storage of oats and the sale of May futures in August, the storage of the oats to March, and the sale of the oats and repurchase of May futures in March.[1]

The average increase in the cash price from August to March was 2.9 cents a bushel, but when the oats were hedged the average margin was 6.5 cents. Difference in cash prices would have led to gains in nine years and losses in seven years. The hedging margin, 6.5 cents a bushel, would have permitted a gain in each of the sixteen years. The 6.5-cents margin was made up of an average discount of 4.7 cents in the cash price under the May future in August, and of an average premium of 1.8 cents in the cash price over the May future in March. In August the cash price was at a discount in fifteen of the sixteen years, and in March it was at a premium in twelve of the sixteen years. In the three years 1934-35 to 1936-37 the discounts in August were small, but substantial premiums developed in the following March, so that the average computed earnings were 4.9 cents a bushel when oats were hedged and 1.8 cents when they were unhedged.

Clearly in this sixteen-year period from 1921 to 1936 it paid better

[1]Calculated as described in the similar comparison for the storing and hedging of corn, page 24.

TABLE 19.—APPARENT EARNINGS FROM STORING OF OATS FROM AUGUST TO MARCH, HEDGED AND UNHEDGED, CHICAGO PRICES, 1921–1937[a]

| Marketing year | Increase in price from March to August | May future in August over cash price | Cash price in March over May future | Apparent earnings from storing, August to March, hedged |
|---|---|---|---|---|
| | *cents* | *cents* | *cents* | *cents* |
| 1921–22 | +3.7 | +6.1 | +1.4 | +7.5 |
| 1922–23 | +12.0 | +3.2 | +1.6 | +4.8 |
| 1923–24 | +8.2 | +1.9 | +1.3 | +3.2 |
| 1924–25 | −2.8 | +4.2 | +2.5 | +6.7 |
| 1925–26 | −1.3 | +5.4 | +.5 | +5.9 |
| 1926–27 | +7.6 | +6.6 | +3.0 | +9.6 |
| 1927–28 | +12.2 | +6.6 | +2.5 | +9.1 |
| 1928–29 | +11.3 | +4.8 | +1.8 | +6.6 |
| 1929–30 | −.9 | +12.1 | −.1 | +12.0 |
| 1930–31 | −8.2 | +7.8 | −.5 | +7.3 |
| 1931–32 | +2.2 | +4.4 | −.5 | +3.9 |
| 1932–33 | +.1 | +3.9 | −.2 | +3.7 |
| 1933–34 | −2.5 | +7.2 | +.8 | +8.0 |
| 1934–35 | −1.8 | +.3 | +5.7 | +6.0 |
| 1935–36 | −.3 | +.5 | +4.0 | +4.5 |
| 1936–37 | +7.5 | −.1 | +4.3 | +4.2 |
| Average, 1921–1937 | +2.9 | +4.7 | +1.8 | +6.5 |

[a]See footnote for Table 9, page 24.

to hedge oats stored from August to March than to carry them unhedged.

## WHEN TO MARKET SOYBEANS

Soybeans have been of commercial importance in Illinois for such a short period that the typical seasonal variation in price cannot be determined from historical data. Certain facts about the crop and its market, however, furnish a basis for inferring what the seasonal variation may be when it becomes established.

The world crop of soybeans is practically all harvested in the fall months. Both of the principal producing countries—Manchuria and the United States—are located in the northern hemisphere, and therefore harvest their crops at much the same season. The consumption of soybean products is distributed thruout the year, altho use of soybean meal for feed is heavier in the winter months and prices have averaged higher then. The demand for beans to be used as seed is concentrated in the late spring months. In years when U. S. exports of soybeans are extensive, they are likely to be largest at seasons when the Great Lakes route is available to furnish cheap transportation to the Atlantic seaboard, a situation which may cause the demand for soybeans for export to be strongest at harvest and again in late spring

and early summer. In view of these conditions, soybean prices are likely to average lowest at harvest and to increase during the marketing season by enough to pay the cost of storage.

So far, the Illinois farm price of soybeans has increased from harvest to the following summer by more than the cost of storage. This situation may be looked upon, however, as an unusual one that will not continue indefinitely, for the seasonal increase in price over a period of years is likely to be more closely related to such costs.

Averages of farm prices of soybeans (on the 15th of the month) for the two periods 1924-1937 and 1931-1937 were as follows:

| | *1924–1937 crops* | *1931–1937 crops* | | *1924–1937 crops* | *1931–1937 crops* |
|---|---|---|---|---|---|
| October | $1.08 | $.64 | April | $1.37 | $.89 |
| November | 1.06 | .67 | May | 1.45 | .96 |
| December | 1.16 | .75 | June | 1.49 | .96 |
| January | 1.29 | .79 | July | 1.47 | .95 |
| February | 1.30 | .85 | August | 1.24 | .78 |
| March | 1.34 | .84 | September | 1.09 | .72 |

For the 1924-1937 crops the average increase in price from October to the following June was 41 cents a bushel, but this period included several years before soybeans became of much commercial importance in Illinois (Fig. 7). For the 1931-1937 crops the average increase per bushel from October to June was 32 cents. In either period the

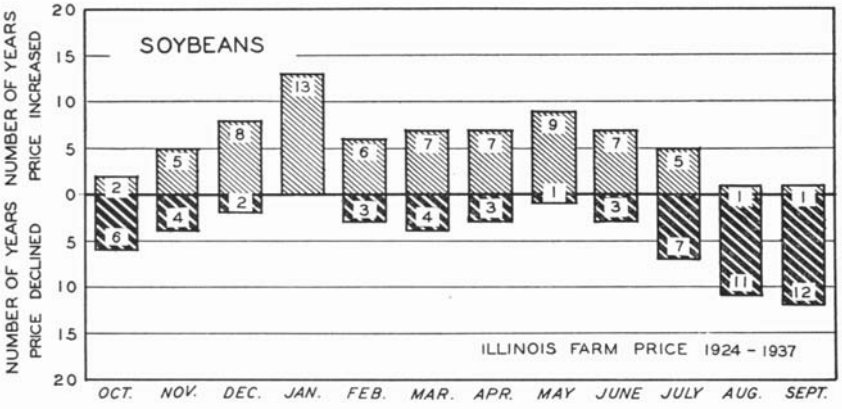


**Fig. 7.—Number of times during fourteen crop years that the Illinois farm price for soybeans was higher or lower than that of previous month, 1924-1937**

From November thru June the average monthly farm price of soybeans has typically advanced over the previous month. From July thru October it has declined.

increase more than covered the costs involved (cost of storing wheat, page 32, indicates in general the cost of storing beans).

One reason why the seasonal rise in soybean prices is so large is that the soybean is a new crop. On many farms the storing of soybeans would mean that new storage facilities would have to be built. Landowners naturally have been slow to make this added investment, particularly in view of the uncertainty about the future of the crop.

TABLE 20.—DIRECTION OF CHANGE IN ILLINOIS FARM PRICES OF SOYBEANS FROM PREVIOUS MONTH, 1924–1937 CROPS

| Month | Average change from previous month | Number of years when price went— | | Average total change from October |
|---|---|---|---|---|
| | | Up | Down | |
| | *cents* | | | *cents* |
| October | ... | 2 | 6 | ... |
| November | −2 | 5 | 4 | −2 |
| December | +10 | 8 | 2 | +8 |
| January | +13 | 13 | 0 | +21 |
| February | +1 | 6 | 3 | +22 |
| March | +4 | 7 | 4 | +26 |
| April | +3 | 7 | 3 | +29 |
| May | +8 | 9 | 1 | +37 |
| June | +4 | 7 | 3 | +41 |
| July | −2 | 5 | 7 | +39 |
| August | −23 | 1 | 11 | +16 |
| September | −15 | 1 | 12 | +1 |

Nevertheless, a trend toward extensive storage of beans is already under way. About one-third of the 1939 Illinois crop was still on farms on January 1, 1940, according to the estimate of the Illinois Cooperative Crop Reporting Service, and about half of the 1940 Illinois crop was estimated to be on farms on January 1, 1941. The 1940 Illinois crop was much smaller than that in 1939, and the actual carryover on Illinois farms on January 1, 1941, was only about 2 million bushels larger than a year earlier.

For the 1924-1937 crops the average farm price during the months from July to October was lower than in the previous month more often than it was higher (Table 20). From November to June increases from month to month were more common than decreases, particularly in December, January, and May.

Several more years will be needed before the seasonal variation in soybean prices is definitely established, but the increase from harvest to the following spring will probably become smaller as more facilities are built to store the crop.

## SUMMARY

In order to select the season of the year in which to sell grain most advantageously, a grower needs to be able to estimate the cost of holding the grain and to know something of the general seasonal patterns of grain prices.

### Corn

**Seasonal patterns in marketing and prices.** Marketings of corn are typically distributed fairly well thruout the year, with a moderate peak at harvest time. The reasons for this rather uniform distribution are (1) the relative economy with which corn can be stored on the farm, and (2) the widespread opinion of farmers that the average advance in price will be enough to make the holding profitable. During the decade preceding 1937 about two-thirds of the previous crop and carryover of Illinois corn was, on the average, still on farms on January 1, about two-fifths was on farms on April 1, about one-fourth on July 1, and about one-tenth on October 1.

Corn prices as a rule have not advanced from November to March; but from March to August in the years 1920-1937 they advanced at Chicago an average of about 10 cents a bushel for No. 3 yellow corn.

Altho month-to-month changes in price during this period did not follow a uniform pattern each year, the price in January, April, May, June, and July was more commonly above that of the previous month than it was below it; and in the other months of the year it was more commonly lower than the previous month, except in December, in which month it was higher and lower an equal number of years.

It is not unlikely, however, that the above trends in corn prices may be modified during the next few years. Loans on corn by the Commodity Credit Corporation may cause the price to rise earlier in the year than formerly, and may thus limit later increases, particularly in years when such loans are above the market price.

The usual seasonal pattern is likely to be modified in any given year by such circumstances as (1) crop scares during the summer months; (2) short supplies and accompanying high prices early in the marketing year, which tend to retard consumption; (3) large changes in numbers of grain-consuming animals during the year; or (4) pronounced changes in the general price-level.

**Storage costs.** The average increase in the price of corn during the marketing season (10 cents a bushel from November to July)

measures the costs of storage as these are estimated by farmers. This is in line with the economic principle that in a competitive industry the necessary return for furnishing a given service tends to equal the cost of rendering the service. Among the various items of cost are interest, insurance, taxes, shrinkage, and risks of damage. Since corn is typically cribbed before sale, the cost of providing cribs is a part of the cost of raising the crop rather than of marketing it, unless space must be built to store the corn for longer than a single year.

When stored corn is sold by grade, either as shelled corn or as ear corn, the shrinkage in weight caused by loss of moisture is largely offset by the better price for the drier corn, unless the corn has been damaged in storage. But if ear corn is sold regardless of grade, shrinkage is a direct item of cost, the extent of which varies from year to year, chiefly according to the moisture content of the corn when it is cribbed. The cost may be partially or completely offset, however, by the adjustment in number of pounds taken as a bushel at different seasons of the year.

**Hedging.** The average earnings on corn stored from December to April would have been increased somewhat during the years 1921 to 1937 had the corn been hedged by sale of future contracts. The earnings on corn stored from December to July would have been reduced slightly by such hedging. Hedging during either period would have made the earnings less varied from year to year.

## Wheat

Wheat is sold as it is harvested more commonly than is corn. But in areas producing soft wheat, particularly in the upland areas southeast of St. Louis, storage of wheat is more common than in other sections of the state.

The sale of most wheat at harvest indicates that farmers do not in general believe that the increase in price will cover the risks of deterioration and the costs involved in farm storage—a belief that seems well supported by the data presented here. Costs of storing wheat at the farm for six months are estimated at 10 cents to 13 cents a bushel; whereas the average increase in price of No. 2 soft red winter wheat at St. Louis between July-August and January (the high month) during 1921-1937 was 11 cents a bushel, and for No. 2 hard red winter wheat at Chicago the average increase from August to February was only 7 cents.

The price of soft red winter wheat in August, September, December, and January increased from the previous month more often than

it declined; in the other months of the year it declined more often than it advanced. The price of hard red winter wheat during the months from September to January, and again in April, increased from the previous month more often than it declined, but in the other months it went down more often than it went up.

Hedging by sale of futures would have made very little difference in the average earnings from storage of soft wheat at St. Louis during the period 1921-1937, but it would have made the margins much more stable.

### Oats

On October 1 about two-thirds of the crop and carryover of Illinois oats remains on farms; on January 1 about one-half remains; on April 1 a little less than one-third; and on July 1 about one-tenth.

During 1921-1937 the average advance in price of oats from August to January, the high month, was about 4 cents a bushel, an amount that just about covers the estimated storage costs. In view of the ease with which oats can be stored on many farms, it is not surprising that the returns just about cover the costs.

Calculated earnings on oats stored and hedged from August to March were more than twice as large as the earnings on oats stored unhedged, and were also more nearly uniform.

Increases in price from the previous month are more common than decreases in September, November, December, January, and April; and decreases are more common in February and March and from May to August.

### Soybeans

The price of soybeans has increased typically by substantial amounts from harvest until the next spring. For the 1931-1937 crops the average increase in the Illinois farm price was 32 cents between October and May-June. Now that the soybean has become an important commercial crop, the seasonal rise in prices will probably be less extensive as more storage facilities become available. The increase in price will then be likely to reflect more nearly the storage costs, which are probably less than those for wheat because of the smaller risk of deterioriation if the soybeans are in a satisfactory condition when stored.

THE PROFIT which a farmer may realize from his crops depends in large measure on his knowing when to market them to the best advantage. Every farmer must figure this best time for himself since there are a number of personal factors that will enter into a wise decision. One essential, however, is knowledge of what the price trends may typically be expected to be during the marketing season, and this can be determined only by long and careful observation or study of the history of crop prices.

This circular supplies such information with respect to Illinois' principal grain crops—corn, wheat, oats, and soybeans. It also gives an analysis of the costs involved in holding the different crops and shows how these costs must be weighed against any anticipated advantages.

Careful study of the material presented here it is believed will help Illinois farmers to place their crops on the market at what will be to each of them individually the most advantageous time.

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